Advances in Engineering Research, volume 209
International Joint Conference on Science and Engineering 2021 (IJCSE 2021)

Gender Disparity in North Sumatera Higher Education and Challenges of Young Indonesian Women in Science and STEM Education

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ABSTRACT
This research presents data from The Higher Education Data Base (PDDikti) in 2019 Higher Education Statistics to investigate the gender representations at higher education level and faculty members limited to universities in North Sumatera. Then, reviewed about challenges of young Indonesian women in science and STEM (Science, Technology, Engineering, and Mathematics) education. Based on the findings, the number of female-registered students in the diploma, bachelor, profession, and specialist over male students was 25,238; 162,036; 4,206 and 296 respectively. At the same time, the number of male students enrolled in master's and doctoral programs over females was 7,980 and 751, respectively. Secondly, the representation of women in the academic workplace presented in universities—University of Medan, University of North Sumatera, and Private universities as 42.89;49.14; and 49.97 in order—was a higher percentage than polytechnic of Medan which only below thirty percent. In fact, at Polytechnic of Medan, it was recorded that the representation of female lecturers was significantly less. The possible explanation is that most program field in this institution is majoring in Engineering, such as Civil Engineering, Electrical Engineering, Mechanical Engineering, Computer Engineering, and Information Technology, etc. where male lecturers are more preferred than female lecturers. Therefore, the women faculty members are underrepresented in STEM-related fields and at senior levels and leadership positions in the university careers. Lastly, for young Indonesian women, studies and careers should not make women forget their nature of female role. The choice of they do not get married to pursue a career has to be the negative stereotypes about young Indonesian women due to the patriarchal system dominated.

Keywords: *Gender disparity, Science, STEM Education.*

1. INTRODUCTION

The Sustainable Development Goal (SDG) 2030 agenda of United Nations calls in Goal 4 for education had emphasized by 2030. The target is to achieve inclusive and equitable education through promoting lifelong learning opportunities for all or, in short, quality education for all [1].

They combine with Goal 5 that gender equality provides equal opportunities to different genders as a fundamental human right to walk further into a sustainable world [2]. Boys, Girls, or women, men have different needs due to their gender differently, societal roles, and rooted in socio-cultural constructions. Illustrated by the male and the female could walk through different ways yet still forwarding to the same end is one fact.

Nevertheless, whether both genders are receiving equal participation in the field is another different story. Unfortunately, gender inequality practices and facts have yet to exist in all sectors of the country's development [3–5], specifically in the education sector [6–8]. The question is about how to provide equal access in pursuing their education and how to pursue their careers in the field of or related to education or in the academic workplace. The discussion about gender inequality will help evaluate whether policies-based gender abides in the contextual practices or projects. Will it be far away from any shape of gender discrimination? Such as stereotypes, gender bias, sub-ordination, double burden, marginalization, violence, or any other practice result from gender ideologies that often reinforce male power over women in the educational setting.

According to the references about gender equality policy in Indonesia, the Presidential Instruction No. 9 of 2000 summon for gender mainstreaming (PUG) on the national developments —starting from planning, designing, monitoring, and evaluating developing programs—in each government agency and sector through gender analysis pathway (PAG) [9]. A strategy to integrate gender differences brings into consideration in all innovation programs and policies. It is also a strategy that takes account of the SDGs calls, which is not only for gender equality but also for equitable and equal education by regard the needs different of men and women [1,2].

Furthermore, the ministry of education of Indonesia released the guideline on how gender mainstreaming is more practically conduct in higher educational practices through Mendiknas 84/2008 [10]. Based on Aruan's explanation in the reports, gender mainstreaming focus on five major areas includes (a) increase the capacity of policymaker in each fundamental unit (b) increase the capacity education planners in gender-responsive planning and budgeting (c) women or genders study centers collaboration among higher education to find gender issues in each religion (d) social organizations collaboration, where the community would develop gender equitable models in families and communities. (e) developing communications, information, and education media [11].

Recently, women's participation in science or Science, Technology, Engineering, Mathematics (STEM) education attracted much attention from researchers locally and globally. As after decades, the representation of women in some areas has increasingly improved. However, other contexts or situations and challenges in practices still need to be explored as gender is a particular term of social constructions, for example, the focus on adjustment for curriculum choice, assessment, and teaching practice to improve the development of women and girls in education is still worthwhile for the men and boys [12].

According to the gender equality policies in Indonesia has described, this research collected the latest data about the gender representations at higher education level and faculty members, reviewed studies concerned to the gender equality policies analysis to discuss what the young Indonesian women' situations and challenges may face when learning math and science.

2. METHODS

This research collected data from The Higher Education Data Base (PDDikti) in 2019 Higher Education Statistics [13] and literature review. The gender representations at the higher education level and faculty members are limited to universities in North Sumatera as the purposive selected sample.

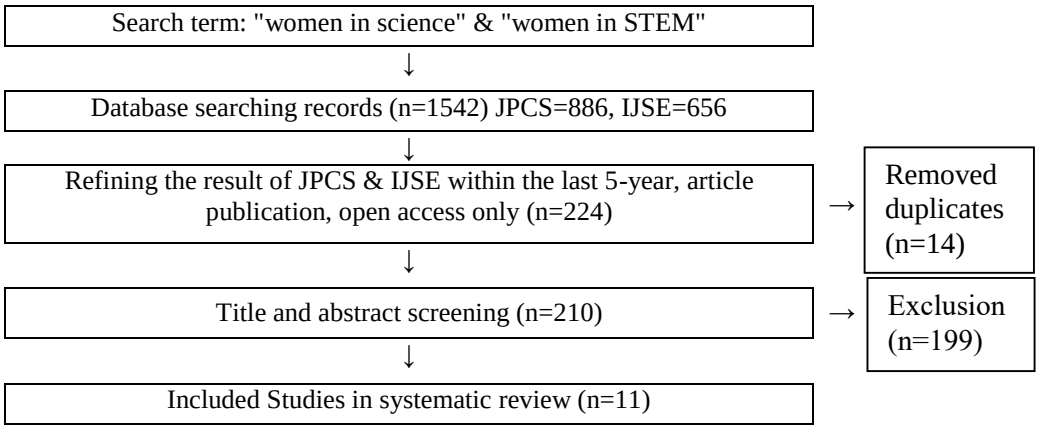

Figure 1 The overview of article screening and inclusion.

Else, this study used the systematic literature review about research topics related to gender representation in Indonesian education, and studies about the situations and challenges of young Indonesian women in science or STEM education has identified within a keyword of "women in STEM education" or "women in science education" from Journal of Physics: Conference Series (JPCS) and International Journal of Science Education (IJSE) search. There were 11 peer-reviewed studies that address gender in relation to

women in science and STEM. Review questions answered by employing studies related to a journal paper, books, commentaries, policy documents, and other types of publications and empirical studies [14]. The initial process started with literature collection, drawing the connections, elaborating with thoughts, and concluding the final steps. In addition, this study also collected information from related topics literature from books and additional articles from other resources to support the discussion.

3. RESULTS AND DISCUSSIONS

3.1. The statistical data of gender disparity representations in North Sumatra's higher education

This data was collected based on the universities lists from the selected region. North Sumatera is the original place where the researcher comes from and has been familiar with the situations of universities.

For the information, the National of Higher Education in Indonesia is divided into three ministries which are Ministry of Research & Technology Higher Education (MoRTHE), includes Public and Private HE, Ministry of Religion Higher Education (MoRHE), such as Public and Private Religion HE), and Other Ministry of Higher Education (oMHE), e.i. School of Law, School of Statistic, etc.). Total higher institutions by 2019 were 4,621 institution [13].

This study data collection focused on the higher institution listed under MoRTHE in North Sumatera, where three public—namely Polytechnic of Medan, University of Medan, and University of North Sumatera—and two-hundred forty private higher institutions listed of the year 2019. Public institutions will present separately, while data from all private institutions combined altogether due to the availability of statistical data. Below is the latest data (2019) of the total number of registered students based on the program level and gender in public and private higher institutions in North Sumatra.

Table 1. Total number of registered students under MoRTHE, North Sumatera

Category	Polytechnic		Univ. of Medan		Univ. of North Sumatera		Private Universities		Total	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Diploma	2,730	3,546	247	88	1,341	1,928	11,705	19,676	16,023	25,238
Bachelor	-	-	9,919	18,758	12,986	18,320	128,253	124,958	151,158	162,036
Master	-	-	827	1,499	3,102	2,707	4,051	3,389	7,980	*7,595*
Doctoral	-	-	171	100	580	405	-	-	751	*505*
Profession	-	-	-	-	536	1,639	1,353	2,567	1,889	4,206
Specialist	-	-	-	-	245	296	-	-	245	296

Based on the findings, the number of female-registered students in the diploma, bachelor, profession, and specialist over male students was 25,238; 162,036; 4,206 and 296 respectively. At the same time, the number of male students enrolled in master's and doctoral programs over females was 7,980 and 751, respectively. The second, the number of lecturers based on gender in North Sumatera higher institutions described in the following table.

Table 2 shows that the representation of women in the academic institutions as a percentage of women. This representation resulted from the available data, the total lecturers in North Sumatera by 2019 was 15,315 people, The representation of women lecturers in universities—University of Medan, University of North Sumatera, and Private universities as 42.89;49.14; and 49.97 in order—was a higher percentage than polytechnic of Medan which only below thirty percent or consisting of 229 men while women are only 92 people.

Table 2. Number of Lecturers based on gender under MoRTHE, North Sumatera

Category	Male	Female	% Women
Polytechnic of Medan	229	92	28.66
Univ. of Medan	518	389	42.89
Univ. of North Sumatera	829	801	49.14
Private Universities	6,232	6,225	49.97
Total	7,808	7,507	49.02

Nevertheless, as the sum of lecturers showed, males and females are nearly equal represented, consisting of 7,808 men or 50.98%, while the representation of women is 49.02 % as many as 7,507 people. However, the reports of students by gender from the PDDikti website showed that in average distribution, the female students are higher than males without educational level information [15]. However, Table 1 showed that slightly fewer female students pursued their education journey up to the master and doctoral level than males. Furthermore, when it came to the educational or educational-related careers—for example, table 2 has described—the gender representation trend remains the same. In fact, at Polytechnic of Medan, it was recorded that the representation of female lecturers was significantly less. The possible explanation is that most program field in this institution is majoring in Engineering, such as Civil Engineering, Electrical Engineering, Mechanical Engineering, Computer Engineering, and Information Technology, etc. [16] where male lecturers are more preferred than female lecturers.

The former study has discovered that the distribution of male and female lecturers based on program field, the field of Engineering has a higher number of lecturers than female lecturers. Meanwhile, in the field of Health sciences, female lecturers are far outperformed. Although the number of female lecturers in Health over males, the distribution of lecturers based on age in the health sciences for female lecturers outperformed male lecturers only at 21-50 years. The rest of the male lecturers outperformed. A similar trend is found in women's representation over men only at the age range of 21-35 years. This study also explains the situation where this phenomenon is also seen when looking at women's representation which is far below based on lecturer positions such as expert assistants, lectors, head lectors, and professors, even to the level of higher education leaders, as well as high-ranking officials within the Ministry of Research, Technology and Higher Education. Thus, gender disparities in Indonesia still occur [11]. Literature of study about career professionals in academia indicated gender difference preferences in academic rank and leadership position between women and men. The women faculty members are underrepresented in science, technology, engineering, and mathematics-related fields and at senior levels and leadership positions in the university careers [17].

3.2. The situations and challenges of young Indonesian women in science or STEM education

Generally, women empowerment is one of the feminist objectives as the deconstruction term in gender to stand before the minorities and empower them. Indonesian often acknowledge the emancipation of women. Since Kartini's success, it introduced—the first role model of young Indonesian women pursuing her education commitment—struggles from patriarchal marginalization. On her writings:
'I can and call me Kartini. I know the road I want to take is challenging, full of thorns, thistles, holes; the road is rocky, uneven, slippery...not yet paved! Moreover, though I would be broken in the halfway, I will die happily.'

The meaning of the emancipation of women for Indonesian women is having equal opportunity between men and women—gender equality in all fields, especially in education journey or academic workplace. However, noted from a study on State University of Surabaya (UNESA)'s magazine about the discourse of women: there was embedded value on the emancipation itself regarding gender role and sex-gender role of Indonesian women. Women shining brightly in their education or academic careers should also be the women with their "nature" role as wives and mothers [18].

Indonesian women, their masculinity contributed significantly to their career commitment, whereas to be committed to family life, they also must shift to feminine orientation because Indonesian women are expected to balance their careers and their family lives. Therefore, studies and careers should not make women forget their nature or the choice of they do not get married to pursue a career has to be the negative stereotypes about young women [19]. They were defining the nature of women from men as the sole as known as a patriarchal system dominated in the community culture. This system arose from the community custom in Indonesia, where men regulate the culture or customs flow or lineage. Therefore, pursuing study and careers, especially in science or STEM-related fields, would need to deal with the patriarchal-related injustices or inequalities practice and discourse about women often in families or larger social communities. Considering why young Indonesian women were so few, the empirical study in the qualitative method was conducted by [20]. Besides depends on the family-related factors, advancement position on women education or workforce trajectory also depends on organizational-related factors such as sex discrimination. For instance, young women were asked about their opinion if they have education titles or careers more advance than prospective spouses. Rather than being asked the more substantial questions related to their dedication, loyalty, and personal capacity resources needed for the positions. Customs, religions, and traditions were involved in the large form of society. The individual-related barriers noted as another factor from the minority group in the

society affects the lower confidence of young Indonesian women capacity to grow.

Different from Indonesian challenges, young Australian women in STEM are considering leaving their science or STEM-related careers with the reason of career advancement lacking. To fulfill the advancement careers criteria, some of them decided to change careers trajectories or study the specialist of particular skills in gaining more experiences, others reason listed because of the gender difference salaries gap, and uncertainty or seldom received equal chances for careers development [21]. Meanwhile, young U.S women were underrepresented in science or STEM education at the undergraduate level because of experiences insufficiency for needed fields, the cultures of masculinity, and gender gaps as self-beliefs. From the natural sciences field—such as mathematics, chemistry, biology, physics, and related sciences: engineering, and computer science—the undergraduate student of male and female for mathematics, chemistry, and biology most likely equal in number as the result of incapability stereotypes and more miniature role modeling of women in these fields [22]

4. CONCLUSION

Although this research still the literature review about gender equality and quality from Sustainable Developments (SDGs) goals as a worldwide call to every country listed under United Nations to the context of Indonesian policy regarding the implication of gender equality policies in the educational setting, the data statistics collected from the latest higher education database 2019 to investigate the woman representation as students in different program level and as lecturers in academic careers at North Sumatera University.

Indonesian young women representative through data collected from universities in North Sumatra has increased to the level diploma, bachelor, profession, and specialist; however, for the future program level, the gender disparity still needs to be improved and at the professional career level. The pyramid-shaped challenges as the future direction of representation of women bring into the structural positions. If two out of five of gender mainstreaming central area is about the increasing capacity of policymakers and planners on educational programs or innovation, how does the woman representation still exist as ideal fifty to fifty to the men representation?

So, suppose we want to strengthen human resources and science and STEM education capability as the SDGs goals. In that case, we must seriously consider women as a source of future scientists, technologists, engineers, and mathematicians; increasing the women's role as equal partners of men should be directed at increasing their active participation in all levels and development programs. Lack of representation of women from science and STEM education is a waste of human resources from a national investment development, career discrimination, organizational culture are important issues. There is a lot of accumulated evidence that organizations with women as team leaders perform better [23–26] This momentum to increase the advancement of women into senior roles. Notably, women in the science sector or the professional STEM sector from different fields come together to be networked and connected as gender role models.

AUTHORS' CONTRIBUTIONS

Riris Marito Tamba: conceptualization, method, drafting and editing manuscript. Chia Ling Chiang: Review, data curation, data visualization and editing.

REFERENCES

[1] United Nations, United Nations Goal 4 Quality Education, Department of Economic and Social Affairs Sustainable Developments, 2015. URL: https://sdgs.un.org/goals/goal4

[2] United Nations, United Nations Goal 5 Gender Equality, Department of Economic and Social Affairs Sustainable Developments, 2015. URL: https://sdgs.un.org/goals/goal5

[3] E. Noerdin, S. Aripurnama, A. Anastasia, F. Anindhita,. Gender Equality and Equity Law: New Hope for Gender Responsive Policy in Indonesia. (2014). URL: https://www.wri.or.id/files/PolicyBrief_Gender_Equality_Equity_Law_Jan_2014_English.pdf

[4] S. Iswandi, R. Yunus, The Implementation of Law Number 6 The Year 2014 Concerning With Villages in Gender-Responsive Development Planning in Uluere District, Bantaeng Regency, IOP Conference Series: Earth and Environmental Science, 473(1) (2020) 012091 DOI: https://doi.org/10.1088/1755-1315/473/1/012091

[5] T. Sofiyani, S. Karimi, M. Noer, S. Tarumun, Gender Role in the Second-Generation Resettler Households in Koto Panjang Hydropower Area, Riau Province, IOP Conference Series: Earth and Environmental Science, 430(1) (2020) 012022 DOI: https://doi.org/10.1088/1755-1315/430/1/012022

[6] N.C. Siregar, R. Rosli, The effect of STEM interest base on family background for secondary student, Journal of Physics: Conference Series, 1806(1) (2021) 012217 DOI: https://doi.org/10.1088/1742-6596/1806/1/012217

[7] R.N. Irfiandaru, N. Nurulsari, Exploring Students' Perceptions of Science, Technology, Engineering, and Mathematics (STEM) in Education and Future Careers Fields, Journal of Physics: Conference Series, 1467 (1) (2020) 012071 DOI: https://doi.org/10.1088/1755-1315/430/1/012022

[8] I.D.A. Nurhaeni, Y. Kurniawan, Gender-Mainstreaming in Technical and Vocational Education and Training, IOP Conference Series: Materials Science and Engineering, 306(1) (2018) 012057 DOI: https://doi.org/10.1088/1757-899X/306/1/012057

[9] Instruksi Presiden, Inpres Republik Indonesia Nomor 9 Tahun 2000 Tentang Pengarusutamaan Gender, 2020. URL: http://jdih.bpk.go.id/wp-content/uploads/2012/02/Instruksi_Presiden_no_9_th_2000.pdf

[10] Menteri Pendidikan Nasional, Permendiknas No. 84 Tahun 2008 Tentang Pedoman Pelaksanaan Pengarusutamaan Gender Bidang Pendidikan, 2008. URL: https://jdih.kemdikbud.go.id/arsip/Nomor%2084%20Tahun%202008.pdf

[11] C. D. Aruan, Sumber Daya Manusia dan Gender Pada Pendidikan Tinggi Indonesia, 2009. URL: https://www.ksi-indonesia.org/assets/uploads/original/2020/03/ksi-1584088333.pdf

[12] K. Scantlebury, D. Baker, Gender issues in science education research: remembering where the difference lies, Handbook of Research on Science Education, 2006.

[13] Ministry of Research Technology and Higher Education, 2019 *Higher Education Statistics 2019*, Kemenristekdikti, 2019.

[14] E. Purssell, N. McCrae, A Brief History of the Systematic Review, (2020) DOI: https://doi.org/10.1007/978-3-030-49672-2_2

[15] Kemdikbud PDDikti - Pangkalan Data Pendidikan Tinggi, 2020 URL: https://pddikti.kemdikbud.go.id/

[16] Polytechnic of Medan Politeknik Negeri Medan. URL: https://polmed.ac.id/

[17] N. Kholis, Gendered Career Productivity and Success In Academia In Indonesia's Islamic Higher Education Institutions N. Kholis, Gendered career productivity and success in academia in Indonesia's Islamic higher education institutions, Journal of Indonesian Islam 6(2) (2012) 341-366 DOI: http://dx.doi.org/10.15642/JIIS.2012.6.2.341-366

[18] O. Jatiningsih, S.M. Habibah, Discourse of women on Unesa's magazine, Journal of Physics: Conference Series, 953(1) (2018) 012152 DOI: https://doi.org/10.1088/1742-6596/953/1/012152

[19] W.D. Mansoer, T.P.S. Oei, Predictors of Career Commitment and Employment Level of Tertiary-educated Indonesian Women, Australian journal of psychology 51(1) (1999) 29-36. DOI: https://doi.org/10.1080/00049539908255332

[20] N. Kholis, Barriers to women´ s career advancement in Indonesian academia: a qualitative empirical study." Advances in Social Science, Education and Humanities Research (ASSEHR) 66 (2017) 158-164. URL: http://digilib.uinsby.ac.id/id/eprint/19495

[21] I. Randall, Women in STEM hit by discrimination, Physics World, 29(2) (2016) 9 DOI: https://doi.org/10.1088/2058-7058/29/2/13

[22] M. Allen, Russia ends pact to curb uranium use, Physics World 29. (11) (2016) 13. DOI: https://doi.org/10.1088/2058-7058/29/11/27

[23] H. McLaren, C. Star, I. Widianingsih, Indonesian Women in Public Service Leadership: A Rapid Review." Social Sciences 8(11) (2019) 308 DOI: https://doi.org/10.3390/socsci8110308

[24] N. Sopiawati, Hastuti, The Role of Women in the Management of Flood Disasters in Bima District, Nusa Tenggara Barat, IOP Conference Series: Earth and Environmental Science, 271(1) (2019) 012030 DOI: https://doi.org/10.1088/1755-1315/271/1/012030

[25] D. Frenti, A.M. Huda, The Function of Indonesian Women Coalition (Kpi) in Efforts To Improve Women Leadership in Blitar City, JARES (Journal of Academic Research and Sciences) 2(2) (2017) 3-3 DOI: https://doi.org/10.35457/jares.v2i2.402

[26] Wiyatmi, M. Suryaman, E. Swatikasari, The Deconstruction of Patriarchal Power against Nature and Women in the Indonesian Novels, Asian Social Science 14(2) (2018) 18 URL: https://pdfs.semanticscholar.org/3b74/3a4584dc90961f051ef08c4f2b70d6589cd5.pdf