Gender Differences in School Students' Perceptions Towards Engineering: A Case Study From Rural South India

N P Subheesh
Department of Humanities and Social Sciences
Indian Institute of Technology Madras
Chennai, Tamil Nadu, India
npsubheesh@ieee.org

E A Ayisha
Department of Computer Science and Engineering
Federal Institute of Science and Technology
Ernakulam, Kerala, India
ayishanavas.e@gmail.com

Vijay Akash
Department of Computer Science and Engineering
St. Joseph's College of Engineering and Technology Palai
Kottayam, Kerala, India
akashvijay@ieee.org

R S Akshay
Department of Electronics and Communication Engineering
Government Engineering College Barton Hill, India
Trivandrum, Kerala, India
akshayrs135@gmail.com

S Sarath
Accenture Solutions Pvt Ltd
Coimbatore, Tamil Nadu, India
sarathsksofficial@ieee.org

K Yadhukrishna
Department of Computer Science and Engineering
College of Engineering Munnar, India
Idukki, Kerala, India
yadhukrishnak@ieee.org

2023 IEEE Global Engineering Education Conference (EDUCON) | 979-8-3503-9943-1/23/$31.00 ©2023 IEEE | DOI: 10.1109/EDUCON54358.2023.10125129

***Abstract*—Gender typecasts have prevailed in higher education since time immemorial. Previous research studies have demonstrated the incongruity in gender representation in almost every higher education sector, including engineering education. Gender-specific variation in perceptions towards engineering education and the engineering profession is a significant area of interest. However, relatively little research has been conducted on gender differences in school students' attitudes and perceptions of engineering. In addition, no such previous study has surveyed students of schools on the rural outskirts. The current study intends to address this research gap by investigating the insights of school students who participated in the 'Rural Students' Technology Enhancement Program (R-STEP).' R-STEP was a technical training program organised by the IEEE Education Society (EdSoc) Kerala Chapter exclusively for less-privileged school students from the rural outskirts of Kerala, a southern state of India. The research study critically analysed the R-STEP participants' responses to a questionnaire survey. The questionnaire was in the regional language, Malayalam, comprising five questions each on engineering education and profession. A total of 220 school students from various districts of Kerala participated in the survey. While 62.5% of female survey respondents indicated that they want to be engineers in the future, it was a more significant 86% in the case of males. Rather interestingly, 16.1% of female participants reported that they do not want to be engineers, compared to only 3.1% of males. This research-worthy fivefold difference between male and female attitudes is critically deliberated in the paper, along with other findings from the study. The paper concludes with a few recommendations to address rural school students' gender-specific attitudes towards engineering.**

***Index Terms*—engineering education, engineering profession, gender differences, gender stereotypes, rural schools, R-STEP**

I. Introduction

The growing significance of STEM (science, technology, engineering and mathematics) education has driven many countries to reform their educational policies in favor of technical learning initiatives. Among them, engineering has gained remarkable recognition due to the active learning culture that it follows. Nowadays, we can see a huge increase in the demand for a career in the field of engineering. As it is clearly known, it is difficult to incorporate an engineering culture at the school level. In addition to this, gender stereotypes have been prevailing all across the globe, especially in the field of education regarding engineering. However, due to the exponential growth in demand for engineering both as an educational field and as a profession, it was necessary to understand how gender stereotypes have affected the perception of students regarding engineering education and the engineering profession. Through this paper, we critically analyze the perceptions of K-12 school students regarding engineering and find out the gender-based differences that exist in their opinions. The participants of this study are the attendees of a technical learning initiative of IEEE Education Society Kerala Chapter, Rural Students' Technology Enhancement Program (R-STEP). R-STEP was an innovative advanced technical training session for higher secondary students living in the rural outskirts of Kerala, India. Its specific objective was to

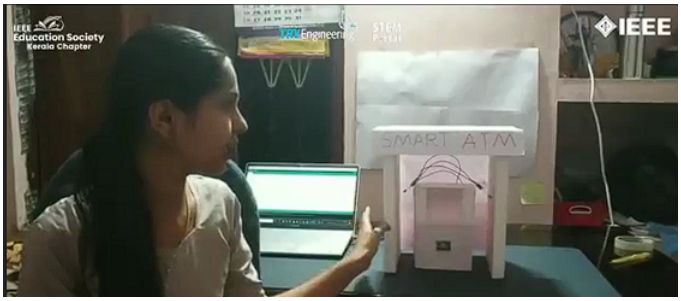

Fig. 1. A female participant demonstrating her R-STEP project

provide the underprivileged student sections with the necessary training to acquaint them with engineering and technology. The data collected from this study was used for analyzing the significant differences in opinions of male and female participants regarding engineering.

A. Rural Student Technology Enhancement Program (R-STEP)

R-STEP was an advanced technical training initiative specially curated for higher secondary students from the rural outskirts of Kerala, India. The specific objective of this program was to provide necessary training to the underprivileged student sections to upskill them with relevant knowledge in engineering and technology. As part of this, the IEEE Education Society (EdSoc) Kerala Chapter provided free hands-on training sessions in Arduino, computer programming, Web Development, and the Internet of Things (IoT). With the help of this initiative, the participants achieved early technical expertise in the in-demand skills in the most sought-after domains in the industry.

B. Significance of the Study and Research Questions

As mentioned earlier, the primary objective of R-STEP was to enable its participants with relevant skills in the in-demand domains of the industry [1]. The participants were from rural sections and represented underprivileged K-12 students. A total of 220 students from similar backgrounds took part in this initiative as participants. Among them, 164 students were males and 46 students were females. All these participants took part in this research study as well. This ensured representations from both male and female categories of students in the study.

As mentioned in the previous section, engineering education and the engineering profession have been experiencing a rapid demand over the years [2]. However, even today, there is no clear understanding regarding the gender-based attitudes of students, especially from rural backgrounds regarding engineering. Though there are a number of studies that are concerned with the impact of engineering education and profession, there exist no such studies regarding rural students' gender-based attitudes towards them. Because of this very same reason, this study was necessary to analyze the situation in an efficient manner. In every way possible, this study clearly presents a differentiation between the perceptions of K-12 regarding engineering. The research was conducted on the following research questions:

1) Is there any gender difference existing in rural school students' perceptions of engineering education and engineering profession?
2) If such gender difference exists, what is its extent and how can it be reduced through practical strategies?

II. Background and Related Works

The perceptions of school students on engineering and engineers has been a topic of interest for researchers for ages, mainly because these attitudes, perceptions and "misconceptions" have the potential to influence their decision to choose engineering as a profession in the future. These works throw light on the extent of frivolous attitudes instilled in them, and how external factors such as societal norms and gender stereotypes influence them.

Though women enroll in STEM disciplines at a rate at par with men, their level of representation and inclusion show a steep decline as one goes up the hierarchy ladder, with only a few rising to the top to occupy leadership positions. What is hindering them? The answer lies in unilateral hierarchy, according to Heike E. Daldrup-Link [3]. Society still considers science, technology, engineering and medicine to be male-dominated, whereas a female entering such domains are considered to be 'alien.' Being bombarded with discrimination, criticism and disapproval significantly affect their perception, confidence and development in STEM disciplines. This has deep-rooted implications, which can be traced to the school level as well.

DAET (Draw An Engineer Test) is a tool used to assess students' attitudes about engineers, wherein they are required to draw an engineer according to their imagination [4] [5]. Multiple researches which employed this tool to analyze the attitudes of school students all led to this staggering observation: most of the drawings depicted male engineers, throwing light on the gender stereotypes being instilled from the grassroot level [6] [7].

In a research conducted by Ayşegül Ergün et al. on fifth and sixth graders [8], problems such as: Do student tendencies towards choosing engineering as a career vary by gender? Do student attitudes towards engineering vary by gender? How do students perceive engineers' gender? How do perceptions of engineers' gender vary by students' gender? were addressed. They found that 57.14% of male respondents considered pursuing engineering in the future while only 38.46% of female respondents responded affirmative. Though no significant relationship was found between students' attitudes towards engineering and their gender, only 12.96% of the students perceived engineers' gender as female while 87.04% perceived the gender as male, thus bolstering the perception of male dominance in engineering. It also observed that female students drew female engineers at a higher rate (23.08%) than male students (3.57%).

A similar trend was observed in the case of high school students (grades 10 to 12) in a research conducted by Patricia

H. Miller et al. [9]. In this research, male students were found to like science courses more than female students, chose it as their favorite subject at higher frequency, and more often planned to choose science, especially in the areas of engineering and computers as their major in college; female students were more "people-oriented" in their interests, preferring courses inclined towards humanities over the physical sciences or mathematics. st in the research by Ünlü and Dömke [10]. Again, participants were found to perceive engineering as a male-oriented profession. Another study by Balçin and Ergün [11] found a difference in perceptions with the gender of respondents: a higher percentage of males opined of engineers as people having good problem solving skills with the ability to multitask, while a large section of the female respondents thought of engineers to use a variety of ways to express their opinions. The research by Ayşegul Ergün et al. [11] also found that most students think of engineers as repairers or constructors, as people who engage in works that require physical effort, and that engineering is considered to be a boring subject that draws only the attention of studious students.

These frivolous perceptions, especially that of female students, affect their future tendencies about engineering. For instance, female students who are of the stereotypical opinion that males are better at science and mathematics were found to have lower success in these fields [12]. Likewise, acceptance of societal engineering gender stereotypes affect the desire of females to be an engineer and their success.

While these studies were done on a rather general group of students, no focus was given to students hailing from rural backgrounds, where such stereotypes are more prevalent than in urban areas. That is where our research is significant.

III. Methodology

The research was conducted on the participants of R-STEP, an initiative of the IEEE Education Society Kerala Chapter. Prior to the collection of data, an extensive pilot study was conducted to eliminate potential discrepancies. The survey questions were carefully formulated so as to know the gender based perceptions of rural students on engineering education and engineering profession.

A. Participants and Tools

While providing total anonymity to the respondents, the data collection was done using Google Forms as the primary tool. About 220 responses were recorded, of which 164 were male and 46 were female. The respondents were higher secondary school students belonging to different rural areas of Kerala. The only personal information gathered from the participants during data collection was their gender. 72.9 percent of participants identified as male, 24.9 percent as female, and 2.2 percent of participants refused to disclose their gender.

The questionnaire consisted of 10 questions, of which 5 were related to engineering education and 5 to the engineering profession. An emoji metre was incorporated as the projective technique, and the questions were framed in the regional language of Malayalam considering the age group and educational background of the respondents. This data was then analysed comprehensively for the gender differences in the perspectives of school-going students of rural South India.

B. R-STEP Questionnaire

The questions used for the survey are as follows:

1) Do you believe that engineering is only for students with higher marks in high school?
2) Do you believe that engineers have the potential to simplify others' lives?
3) Do you agree that engineering education can offer you many possibilities for your future?
4) Do you believe that an engineering degree is suitable for only students with high mathematical skills?
5) Do you agree that there are possibilities for social interaction in the engineering profession?
6) Do you agree that engineering education promotes practical learning?
7) Do you agree that engineers have proficient knowledge of science?
8) Do you believe that engineering is only for students with high drawing skills?
9) Do you agree that engineers possess high problem-solving skills?
10) Do you want to pursue an engineering profession in the future?

Even though the study successfully accomplishes our goals, there are still some restrictions. Due to limitations, we were unable to include questions on how the students' families felt about engineering school and the engineering field. Such inquiries would have provided us with a wider perspective when examining the effect of a family's attitude on a child's schooling. In addition, we took into consideration gender-specific questions. Such inquiries aided in our deeper comprehension of the gender gap in engineering education and the engineering profession. We included these topics for future research since our goal was to precisely grasp how rural school students felt about engineering education and the engineering profession. This study was carried out as a part of the R-STEP project of the Kerala Chapter of the IEEE Education Society. As a result, the majority of our participants were students who had a background in technical fields. This choice restricted our ability to grasp the attitudes and opinions of rural students as a whole.

IV. Findings and Discussions

The results to the central question of the survey on which the whole research rests upon are given in Table I. For this question on their inclination towards opting for a career in engineering in the future, about 62.5% of female survey respondents want to be an engineer in the future, while a whopping 86% of males want to be an engineer. In contrast, 16.1% of females have decided not to be an engineer compared

TABLE I
DO RURAL SCHOOL STUDENTS WANT TO BECOME ENGINEERS?

Questions	Agree		Not sure		Disagree	
	M (%)	F (%)	M(%)	F (%)	M (%)	F (%)
Do you want to pursue an engineering profession in the future?	86.0	62.5	10.9	21.4	03.1	16.1

TABLE II
RURAL SCHOOL STUDENTS' PERCEPTIONS OF THE ENGINEERING EDUCATION

Questions	Agree		Not sure		Disagree	
	M (%)	F (%)	M(%)	F (%)	M (%)	F (%)
Do you believe that engineering is only for students with higher marks in high school?	34.1	30.5	32.9	32.1	33.0	37.4
Do you agree that engineering education can offer you many possibilities for your future?	78.6	75.0	14.1	17.9	07.3	07.1
Do you believe that an engineering degree is suitable for only students with high mathematical skills?	34.9	26.7	28.6	41.2	36.5	32.1
Do you agree that engineering education promotes practical learning?	74.7	82.1	14.0	16.1	04.3	01.8
Do you believe that engineering is only for students with high drawing skills?	10.4	17.9	31.7	26.8	57.9	55.3

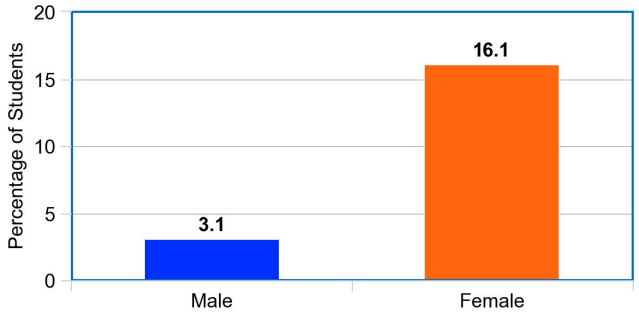

Fig. 2. Gender wise percentage distribution of rural school students who do not want to be engineers

to only 3.1% of males. This five-fold difference in the hesitation to be an engineer is a clear sign of a superior influence of external factors in the decision of female students.

This can be closely related to the United Nations Educational, Scientific and Cultural Organization (UNESCO) and International Association for the Evaluation of Educational Achievement (IEA) brief [13]: 'Missing out on half of the world's potential: Fewer female than male top achievers in mathematics and science want a career in these fields'. Using the IEA's Trends in International Mathematics and Science Study (TIMSS 2019) data, it found that more males than females at grade 8 want to pursue a career related to mathematics or science. Here, "confidence level" of students in different fields play a key role in the careers they choose. In particular, confidence in mathematics and science is directly linked to career aspirations in STEM [14] [15].

The fact that females tend to have lower confidence in mathematics and science abilities compared to males is of paramount significance in this context [16] [17]. This is despite the finding from the TIMSS 2019 data that science and mathematics achievements of males and females at the grade 8 level are similar in many countries, with girls even outperforming boys in some countries. Also, more high-performing boys than girls with the same level of achievement in mathematics enter a career in mathematics, and more low-performing boys than girls aspire to enter a career in the same, implying that males are "overconfident" in their mathematical abilities, while females are "under-confident" in theirs. Further, young women who have high levels of achievements in mathematics and science opt for medicine, biology, or psychology majors rather than engineering, mathematics and physics [18].

These two factors may have played a key role in this significant difference in our survey in the willingness of pursuing engineering between the two genders. The confidence of females in science and mathematics can be adversely affected by parents, peers, teachers and other elements of the society who still believe or even promote stereotypes in STEM [19] [20] [21] which is more pronounced in rural areas. Also, materials for teaching and learning are found to actively promote stereotypes in STEM. For example, only 6% of the characters in grade 6 science textbooks of Chile were female [22].

Table II and III explores students' perceptions regarding the engineering education and the engineering profession. Here, more females disagree with engineering being only for students with higher marks in high school while more males agree to this. Congruent with the discussion on Table I, males believe that engineering is suitable for students with high mathematical skills and high problem solving skills more than females. Females tend to believe more than engineering education promotes practical learning and requires high drawing skills. The differences to the responses of remaining questions are not statistically significant. But from a gender-neutral perspective, more students believe that engineering offers a wide range of possibilities for the future, tends to simplify peoples' lives, requires a proficient knowledge of science, and offers opportunities for social interaction.

According to social cognitive theory, people observe, code, and imitate the behavior of others. When the person being observed demonstrates a high level of skills in an area while

having characteristics similar to the observer, the belief of the observer that they can achieve the same level of skill is positively reinforced [23]. Such early exposure of children to veterans of a specific occupation significantly influences their future career development [24]. Unfortunately, students of rural areas have little contact with "role models" in STEM, particularly females in the field. This restricts their knowledge of the STEM fields, consequently promoting information gap between the students of rural and urban areas and subsequently fewer rural students, especially girls, enter the STEM field.

Cultural beliefs which are highly influenced by stereotypes bias opinions according to gender, race and background as well [25]. In our case study, the families in rural South India tend to force female students to discontinue their education at a young age, with the opinion that they are to be married off once they reach the legal age. The family's lack of understanding of various STEM fields lead them to impose traditional views on selecting a career based on gender sustainability, salary, prestige, laboriousness, etc. Here, the fact that engineering is perceived to be a labor-intensive field may come into play, forcing them to believe the field to be more suitable for males.

To substantiate the effect of stereotypes, a study on female college students in Taiwan [26] found that the students held no gender stereotypes on computer profession during elementary school but became fully aware of the same before joining college, implying that they had learnt it during high school.

Thus, a host of factors, such as information gap, less number of role models in STEM, social inequality, digital divide and sociodemographic characteristics may have led to the disparities in the responses of males and females to the survey as found in our research.

V. Recommendations based on the Findings

A key finding of this study is the fivefold difference between male and female students' choice of engineering as their potential career. A fivefold number of female rural school students, compared to male students, indicated that they do not want to be engineers in the future. Other findings in our research are consistent with the studies conducted on the general public group of school students. A fraction of students, especially girls from rural backgrounds, were found to have misconceptions and frivolous attitudes towards engineering education and the engineering profession. Several reasons can be attributed to the same. For instance, rural students' lesser chance of acquaintances with engineers, lack of guidance and training programs, limited access to mainstream media, and various societal stigmas rooted in archaic patriarchal norms can be a few. Specifically, female students' confidence in engineering education and the profession can be undesirably affected by parents, teachers, peer students and other stakeholders who perpetuate gender stereotypes. The incorrect perceptions developed by all these can critically influence the potential career paths of students, especially girls, hailing from rural outskirts. In this regard, we propose the following recommendations for practice to effectively address the gender gap in rural school students' perceptions of engineering.

1) Rural school teachers need to be trained on gender-transformative STEM instructional strategies highlighting engineering education. School teaching and learning materials should be free from gender bias.
2) The school support system must encourage girls to pursue higher studies in engineering and allied disciplines. Preconceived frivolous notions about engineering education and career, if any, must be corrected. Rural school students need to be provided with adequate information on engineering career options.
3) Moreover, informal cocurricular activities, training camps and workshops targeting female secondary school students can be beneficial in enhancing their confidence in engineering. Other interventions incorporating female role models can also be organised. Rural schools must ensure students' access to female mentors and successful female role models in engineering. Parental outreach programs for people from rural areas can also be initiated to confront gender stereotypes about women in engineering.
4) Introducing various initiatives of IEEE and IEEE Education Society to rural schools can tellingly address the societal perception of engineering and associated gender bias issues. As a globally recognised organisation with many engineering experts, IEEE interventions can boost rural school students' and teachers' awareness of engineering.
5) Undergraduate engineering students volunteered to mentor the school students in R-STEP. This has obtained promising results regarding rural school students' perception of engineering and technology. Involving engineering students in awareness sessions and training programs for school students can be a win-win situation for both. Engineering students can get teaching, and practical engineering experience, whereas school students will get engineering awareness. Besides, mentorship of undergraduate students, who are closer to the school students' age group, can inspire peer-to-peer learning.

VI. Conclusion and Future Scope

This research study found that among school students from a rural background, most male students preferred engineering as their future career option. In contrast, a significant number of female students were not subscribing to this idea. Students' misapprehensions regarding engineering as an educational field and as a profession were critically analysed in this study. As the frivolous and indifferent attitudes cannot be neglected, it is exceedingly crucial to make school students, especially from rural areas, aware of engineering education and the engineering profession. In this regard, this paper offers a few practical recommendations to lessen the gender differences in rural school students' perceptions and attitudes towards engineering.

This study is not free from its inherent limitations. It was performed only for a limited geographical area of rural India with above 200 higher-secondary students. Future studies can

TABLE III
RURAL SCHOOL STUDENTS' PERCEPTIONS OF THE ENGINEERING PROFESSION

Questions	Agree		Not sure		Disagree	
	M (%)	F (%)	M (%)	F (%)	M (%)	F (%)
Do you believe that engineers have the potential to simplify others' lives?	78.7	75.0	15.9	17.9	05.4	07.1
Do you agree that there are possibilities for social interaction in the engineering profession?	61.0	66.1	25.0	23.2	14.0	10.7
Do you agree that engineers have proficient knowledge of science?	71.9	67.8	23.2	23.3	04.9	08.9
Do you agree that engineers possess high problem-solving skills?	75.0	64.3	20.7	28.6	04.3	07.1

be conducted for a wide geographical area on a national and international level and for school students of all grades to validate the research findings. The questionnaire presented can be augmented to include questions related to the basic engineering concepts for an extensive study. Further studies can also develop a framework incorporating critical initiatives to eradicate gender stereotypic misconceptions of school students on engineering education and profession. More advanced studies are required to comprehend better the relationship between rural school students' gendered attitudes and the engineering pathway.

VII. ACKNOWLEDGMENTS

First and foremost, we would like to extend our heartfelt gratitude to the IEEE Education Society (EdSoc) Kerala Chapter for encouraging us to conduct this research study. We also thank the IEEE Kerala Section for its kind patronage. We are truly indebted to the IEEE Pre-University STEM Grant Program for funding the Rural Student Technology Enhancement Program (R-STEP). A special thanks go to Prof. Gayathri Manikutty, Chair, Women in Engineering (WiE) Activities, IEEE EdSoc Kerala Chapter, for her supervision and constant support. Most importantly, we would like to thank the school students who participated in the R-STEP and voluntarily undertook the questionnaire survey for this study.

REFERENCES

[1] E. A. Ayisha, A. Vijay, I. Parvathy, S. Sarath and N. P. Subheesh, "Rural School Students' Attitudes and Perceptions toward the Engineering Education and the Engineering Profession," 2022 IEEE Frontiers in Education Conference (FIE), Uppsala, Sweden, 2022, pp. 1-7, doi: 10.1109/FIE56618.2022.9962640.

[2] Subheesh, N. P., and Satya Sundar Sethy. "Learning through assessment and feedback practices: A critical review of engineering education settings." EURASIA Journal of Mathematics, Science and Technology Education 16.3 (2020)

[3] Daldrup-Link, Heike E. "The Fermi Paradox in STEM—Where Are the Women Leaders?." Molecular Imaging and Biology 19.6 (2017)

[4] Fralick, Bethany, et al. "How middle schoolers draw engineers and scientists." Journal of Science Education and Technology 18.1 (2009)

[5] Capobianco, Brenda M., et al. "What is an engineer? Implications of elementary school student conceptions for engineering education." Journal of Engineering Education 100.2 (2011)

[6] Karatas, Faik O., Amy Micklos, and George M. Bodner. "Sixth-grade students' views of the nature of engineering and images of engineers." Journal of Science Education and Technology 20.2 (2011)

[7] Knight, Meredith, and Christine Cunningham. "Draw an Engineer: Development of a tool to investigate students' ideas about engineers and engineering." 2004 Annual Conference. 2004.

[8] Ergün, Ayşegül, and M. Doğukan Balçın. "Perceptions and attitudes of secondary school students towards engineers and engineering." Journal of Education and Practice 9.10 (2018)

[9] Miller, Patricia H., Jennifer Slawinski Blessing, and Stephanie Schwartz. "Gender differences in high-school students' views about science." International journal of science education 28.4 (2006)

[10] Ünlü, Zeynep Koyunlu, and İlbilge Dökme. "Özel yetenekli öğrencilerin FeTeMM'in mühendisliği hakkındaki imajları." Trakya Üniversitesi Eğitim Fakültesi Dergisi 7.1 (2017)

[11] Balçın, Muhammed Doğukan, and Ayşegül Ergün. "Secondary School Students' Attitudes and Perceptions about Scientists" European Journal of Education Studies (2018)

[12] Chatard, Armand, Serge Guimond, and Leila Selimbegovic. ""How good are you in math?" The effect of gender stereotypes on students' recollection of their school marks." Journal of Experimental Social Psychology 43.6 (2007)

[13] De Soysa, Lilamani, and Sarah Zipp. "Gender equality, sport and the United Nation's system. A historical overview of the slow pace of progress." Sport in Society 22.11 (2019)

[14] Pajares, Frank. Gender differences in mathematics self-efficacy beliefs. Cambridge University Press, 2005.

[15] Sheldrake, Sheldrake, Richard. "Students' intentions towards studying science at upper-secondary school: the differential effects of under-confidence and over-confidence." International Journal of Science Education 38.8 (2016)

[16] DeWitt, Jennifer, et al. "Young children's aspirations in science: The unequivocal, the uncertain and the unthinkable." International Journal of Science Education 35.6 (2013)

[17] Liu, Ran. "Gender-math stereotype, biased self-assessment, and aspiration in STEM careers: The gender gap among early adolescents in China." Comparative Education Review 62.4 (2018)

[18] Bieri Buschor, Christine, et al. "Majoring in STEM—What accounts for women's career decision making? A mixed methods study." The Journal of Educational Research 107.3 (2014)

[19] Carlana, Michela. "Implicit stereotypes: Evidence from teachers' gender bias." The Quarterly Journal of Economics 134.3 (2019)

[20] Kelley, Todd R., et al. "Increasing high school teachers self-efficacy for integrated STEM instruction through a collaborative community of practice." International Journal of STEM Education 7 (2020)

[21] Trusz, Sławomir. "Why do females choose to study humanities or social sciences, while males prefer technology or science? Some intrapersonal and interpersonal predictors." Social Psychology of Education 23.3 (2020)

[22] Covacevich, Catalina, and Gastón Quintela-Dávila. "Desigualdad de género, el currículo oculto en textos escolares chilenos." (2014)

[23] Bandura, Bandura, Albert. "Social foundations of thought and action." Englewood Cliffs, NJ 1986.23-28 (1986).

[24] Betz, Nancy E. "Self-concept theory in career development and counseling." The career development quarterly 43.1 (1994)

[25] Correll, Shelley J. "Constraints into preferences: Gender, status, and emerging career aspirations." American sociological review 69.1 (2004)

[26] Fan, Tai-Sheng, and Yi-Ching Li. "Gender issues and computers: college computer science education in Taiwan." Computers Education 44.3 (2005)