Understanding Motivation of Young Women to Start Career in STEM

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Abstract

In most developed countries today, having a work force with skill sets in Science, Technology, Engineering and Mathematics (STEM) are seen as essential to long-term economic growth. In many countries, the demand for STEM workers is expected to grow faster than any other occupation over the next decade. Yet the research shows that females are underrepresented in STEM-related fields. The numbers of females entering into STEM careers is generally lower than males, but there are countries such as Lithuania where females account for a greater percentage than males in other fields or occupations. But more importantly, the workforce requires an increase in female participation in STEM occupations as we transition towards a more global economy. Today there are more women starting their own business, and assuming management roles in companies and large organizations. Research indicates that females, as entrepreneurs and innovators, are just as successful as their male counterparts. Females attending universities to pursue a degree in a STEM-related discipline is now on the rise, a trend that is vital both economically and socially. The aim of the study is to identify the barriers women face entering STEM careers, and better understand the challenges from an entrepreneurial perspective.

Keywords: STEAM, career, young women

Introduction

The career choices of Generation Z women in STEM (Science, Technology, Engineering, and Mathematics) fields are influenced by a complex interplay of social, cultural, and educational factors. From an early age, children begin to think about what they want to be when they grow up. Even then, their aspirations are shaped by stereotypes. The toys and activities they are given shape the skills that will be important not only in work but also in life. Adults also have a strong influence on children by being role models. Studies have shown that children begin to associate different occupations with a particular gender at an early age. Girls are more likely to choose studies or vocational training education, health, social sciences and the humanities when they grow up, while boys are more likely to choose and complete studies or vocational training in science, technology, engineering and mathematics (STEM). While many factors can influence such decisions, it is important to discuss the impact of gender stereotypes. Gender inequalities in education are repeated in the labour market. It affects both incomes

and careers. For example, salaries in the care sector are much lower than in the male-dominated energy or construction sectors. 2 out of 3 young women in Lithuania complete tertiary education. Only behind Canada and South Korea, Lithuania is one of the leaders among Organisation for Economic Co-operation and Development (OECD) members in terms of the number of women aged 25-34 who have completed tertiary education. However, girls are much less likely than boys to study science and technology, which are associated with greater competitiveness in the labour market. According to PISA surveys, in adolescence, both girls and boys show similar interest in science careers. However, when it comes time to choose their studies, five times fewer girls than boys choose STEM fields. While only 9% of girls who want to pursue higher education cite STEM as their first preference, boys' interest in STEM is much higher, with 49% of boys prioritising STEM studies. Thus, even after graduating in science and technology, girls are less likely to be successful in this career field. One year after graduation, one in two young men and one in three young women were working in STEM. The aim of the study is is to identify the barriers women face entering STEM careers, and better understand the challenges from an entrepreneurial perspective. For the methodological purposes the paper is divided into three parts. The first part is devoted to the literature review. The second one describes the methodology. The third analyses the results.

Literature Review

In Lithuania, as in other European and world countries, in the light of changes in society and Technological education content has begun to be more closely linked to the development of technology and the changing objectives of education to scientific knowledge, and it is envisaged to provide students not only with practical (working) knowledge, but also with project work (design) skills, to develop future creative technology developers and, at the same time, responsible The aim is to strengthen the links between general education and the world of work, but this has not always been the case. In 1992, the content of the work-based learning curriculum was differentiated according to the gender of the pupils and, as a result domestic work for girls (basic nutrition, meal preparation), which was differentiated by the school curriculum (food preparation, clothing construction, modelling and sewing, household organisation, basic economics, handicrafts, domestic culture) and technical work for boys (woodwork and metal work, electrical engineering, home improvement and repair work). The explanatory part of the programme noted that it was necessary to assess and guide children's inclinations towards certain areas of work. The document gave children the opportunity to choose an area according to their interest and need. Children were given a choice of the area in which they would learn in the lessons (Urbietis, 2005). It is noted that this practice did not take place. Moreover, the influence of educational environments cannot be understated. Reinking and Martin (2018) argue that the educational system plays a critical role in shaping girls' attitudes toward STEM, suggesting that early exposure to STEM subjects and positive reinforcement can significantly impact their career choices (Reinking & Martin, 2018). Programs that promote STEM awareness and provide mentorship opportunities are essential for fostering interest among young women. For example, the first Robotics program has been shown to enhance students' interpersonal skills and increase their likelihood of pursuing STEM careers (Inbar 2020).

One significant factor affecting career choices among Generation Z women is the role of socialization and cultural perceptions surrounding STEM. Research indicates that societal expectations and gender stereotypes can discourage young women from pursuing STEM careers. For instance, Warsito (2023) emphasizes that girls often perceive STEM fields as male-dominated and may feel that these careers are not meant for them, leading to a reluctance to engage with these subjects. The scientific literature emphasize environmental and personal factors as well (Iroaganachi et al., 2021; Novakovic & Fouad, 2012). Bandura's social cognitive theory and Lent's social cognitive career theory suggest that self-

efficacy, interests, and values are key determinants of career choice intentions (Enes et al. 2023). Further, parental and family influences are particularly important, as they can shape girls' values, interests, and perceptions of STEM careers (Akter et al., 2022; Ardies et al., 2021). The other factors, such as positive role models, mentors, and peer support can also foster a stronger STEM identity and sense of belonging among young women (Ardies et al., 2021; Bystydzienski & Brown, 2012). However, the gender stereotypes and the masculine image associated with STEM fields can act as significant barriers, discouraging girls from pursuing these careers (Makarova et al., 2019; Dicke et al., 2019). Meanwhile, addressing these stereotypes and creating more inclusive and welcoming environments in STEM can help attract more young women (Sassler et al., 2017; Kim et al., 2018). In addition, the exposure to STEM subjects and hands-on experiences, such as through robotics programs or university workshops, can positively influence girls' career intentions and engagement with STEM (Barkatsas et al., 2019; Selvam, 2019). The timing of career-related interventions are significant, as career aspirations and pathways are often formed during the adolescent years (Napier, 2023). Efforts to encourage girls to take advanced STEM courses in high school and recruit them into college STEM majors can help increase the pool of women entering and persisting in STEM fields. Additionally, factors such as work-life balance, flexibility, and the perceived compatibility of STEM careers with personal values and goals can also shape girls' career choices (Dicke et al., 2019). In summary, a multifaceted approach that addresses gender stereotypes, provides supportive environments, fosters STEM identity, and targets earlier educational and career experiences can be effective in motivating young women to choose STEM careers.

Methodology

The methodology of the research is based from experience and observation. The survey has been carried out in early 2024. For this the questionnaire has been distributed among high schools in Lithuania. The targeted age group were 16-18 years old. The total sample was 472 young girls. The questionnaire has following parts: the demographic evaluation, entrepreneurial abilities, future perspectives and general opinion questions. Questions included age, and Lithuanian region. The questionnaire also included a general ability test. The purpose of this added general abilities test was to determine if young women 16-18 age group has the cognitive ability to work in STEM fields. The questions (tasks) have been formulated where the young women had to utilize their mind, imagination and knowledge in science. Areas of the questionnaire such as key competencies were extracted from a prior research study in order to build on existing studies. The entrepreneurial ability part gives information about the skills in starting a business and ability to work in a managerial position. The respondents were asked to evaluate their life values and priorities. The test taker was suggested to choose one of the five options that best fit their opinion. The options were based on 5- point Likert's scale (from strongly agree; agree; neither agree nor disagree; disagree to strongly disagree). When neither agree nor disagree was chosen, it could have a duel meaning; the woman had no answer to the question or that the woman was not sure what to answer. This allowed to analyze the tendencies. Examples of statements asked in this section include: I am willing to take higher risk when it can result in higher rewards…., I am able to make decisions under pressure…. and I enjoy managing and guiding others…..

The next section of statements referred to future perspectives. The goal of this section was to analyze woman's plan in their future. For example, if they prefer a career in STEM fields, why or why not. This part includes three headlines with statements or terms beneath them. The principle is the same as it was in the entrepreneurial ability test with five possible answers to choose regarding the degree of their opinion in relation to the statement or term. The first headline asked them to choose who or what influenced or influences the choice of the future career. Possible answers included: family, friends, family traditions, potential income, hobbies and self-realization goals. In the second part there was a list

of some business sectors and categories of jobs. Under the headline titled: in the future I might see myself as'….the study seek to analyze how much young women are able to identify with these jobs that are listed. Examples include: self-employed, mechanical engineer but also hairdresser. The spectrum of possible answers encompassed a wide variety of jobs not limited to STEM careers. Again, the test taker had five answer choices ranging from strongly disagreed to strongly agreed with the career choice listed. The third headline from the part of future perspectives was: If I start my own business, it would be in…. This covered the entrepreneurial sector. This section was dedicated to identify in which field the woman most identified with. The goal of this section was to find out which business sector was the most attractive to young women. The list of business, provided for the respondents, was compiled in accordance to Eurostat classification.

The last part of our questionnaire asked the woman general opinion questions. This part was divided into two sections. The first asking, please express your opinion on following statements and the second question asking what main obstacles do women face when competing with men in STEM…. The first task asked the women to classify the given statements about their opinion to STEM with the same range of possible answers from previous sections. Statements like 'I think I have the skills needed to work in STEM-related fields' and 'I believe it is as easy for women as it is for men to work in the area of STEM' were asked. Then the questionnaire went into the section part, which was to express their opinion on the relation to men in STEM fields. Statements like 'Women are more involved in concentrating of taking care of family and children, than men' has been given. This section targeted to clarify how many prejudices exist and if it is harder for women than for men to make a career in STEM. For example, whether the possibility that women drop out because of a pregnancy influences their chance of a career in STEM fields.

The objective for the research with questionnaires was to get as much information from women in multiple age groups as possible. With the data, it is possible to characterize and analyze, how women's opinions affect their decision to enter STEM careers.

Results

The Challenges and Tendencies of Generation Z

The research of females between ages 16 and 18 has been carried out in Lithuania. The majority of respondents were at age 18 (52.3%), the second largest age group was 17 (31.5%), the third largest, 16.2% were at the age of 16. In order to find out whether the girls of generation Z have abilities needed to engage in STEM business sectors, 11 general ability questions testing their mechanical, linguistically, logical and visual abilities were compiled. The analysis of data showed that the last visual ability question was the most difficult (Figure 1).

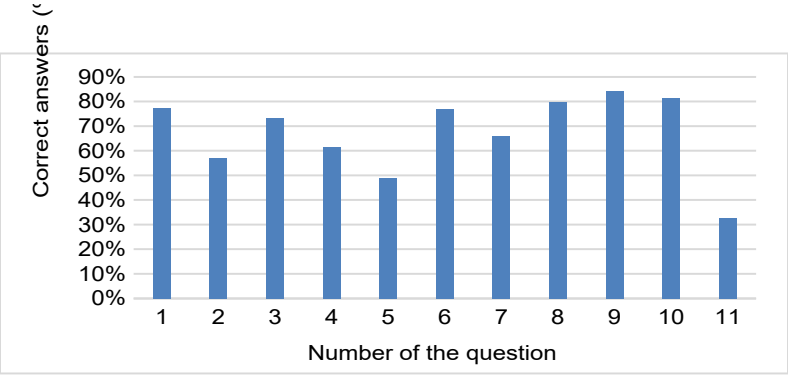

Figure 1: Correct general ability test answers

Only 33% of all respondents managed to answer it. The three logical thinking questions were the easiest ones. Approximately 80% of the respondents answered them right. The responses of the remaining questions varied within the regions but the overall situation was quite satisfying. To summarize the results, 67% of all female respondents had required general abilities to pursue their further career in STEM areas.

Further research was focused on evaluation of entrepreneurial abilities of generation Z. The respondents were asked to evaluate several statements, regarding their key competences, by disclosing whether they more agree or more disagree with the statement. Since among the statements it was possible to distinct few main factors and the number of respondents and the number of statements were quite large, it was decided to use factor analysis for the investigation of the results.

Data set of key competences was checked for adequacy and reliability by calculating Cronbach's Alpha, KMO and Bartlett's Test of Sphericity. The obtained results indicated that data was suitable for further investigation, since the numbers were equal to 0.740 and 0.839 respectively, and the result of Bartlett's test was below 0.05. Correlation matrix didn't show strong correlation between variables; thus the detailed analysis of the factors was carried on.

Total explanation variance and component matrix showed that there were 8 main factors that interpret selected variables; however, evaluating the influence by each factor, the first factor could be considered as domineering one. Since almost all key competences were explained by the first factor and the results were hard to interpret, thus the component matrix was rotated. After using the varimax rotation method, the first factor explained 22.33 % of total variance and it was composed of four variables (dynamism, team working, self-control and responsibility), the second one explained 8.67 % of total variance and it was composed of three variables (self-confidence, initiative and leadership), third explained 7.40 % of total variance and covered three variables (lifelong learning, time management and results orientation). Fourth explained 6.2 % of total variance and it was composed of three variables (development of social networks, innovation and collaboration), fifth explained 5,69 % of total variance and it was composed of one variable (communication). Overall, five factors accounted for more than 50 % of variance. The results led to the conclusion that 76.37% of the girls of generation Z had competences from the first factor and 69.38% from the second factor. Thus, it might be stated that in general, 72.87% of generation Z women had the needed competences and are prone to entrepreneurship.

Female respondents of this age group are exactly the ones that are at the point of choosing their future career and by making-decision; most of them face some kind of influence on their career choice from their close environment (Table 3). The self-realization was the key factor. Female respondents were also asked to identify in which out of the given careers, professions they might see themselves in the future.

Table 3: Influence on the future career

Priority	**Influence**
1	Self realization goals
2	Hobbies
3	Biggest job satisfaction
4	Potential income
5	Desire to start business
6	Family

7	Attractiveness in job market
8	Popularity
9	Friends
10	Family traditions
11	None of these

Young women would prefer career in financial sector. Various types of managers and analysts, real estate agents, secretaries or administrative assistants are among key choices. Hence, young women do not put aside event planning, customer representation, clothing design, law and journalism as well. Focusing particularly into STEM area, IT happens to be quite popular. Unfortunately, most of the other STEM related professions were at the bottom of the female choice list comparing to their key choices. Engineering, Microbiology, Physics, Mechanics were concluded to be among the most unpopular future choices for 16 – 18 years females. In the line with the aim of the paper, the tendency of gen Z girls to join STEM business areas was explored as well. Concentrating to the women starting business themselves, there were several business areas to create business in. They were asked to disclose how much they would like to establish business in each of the given areas. Young women would prefer establishing business in the areas of hotel, restaurant and catering services (65.8 %), media and communications (63.44 %), textile (62.4 %), business (59.2 %) or public services (56.4 %), while mining (42.4 %), electrical machinery and optical production (42 %), fuel (40.8 %), rubber and plastics (39.6 %) and motor trade (39 %) areas are remaining at the bottom of their choice list. Even though list of business areas differed among Lithuanian regions; thus, it is notable that business areas related to technology, mining, electricity and transportation were the least attractive for young women at the ages from 16 to 18.

First question asked to disclose their opinion on several statements. To analyze these results, factor analysis was chosen. Analyzing the generalized data from all three countries by factor analysis, all needed test showed that the variables were adequate and reliable, since the KMO test was 0.745, Cronbach's alpha was 0.788 and Bartlett's test was lower than 0.05. There was no strong correlation between variables. Total variance showed that there were 2 main factors interpreting the results. However, according to the component matrix, first factor is considered to be the highest related to almost all variables, thus, varimax rotation was needed. Rotated component matrix disclosed that the first factor explained 42.19 % of total variance and it was composed of four variables (women willingness to pursue career in STEM, wish to study in area of STEM, thinking of having needed skills to work in STEM and having self-confidence in STEM). The second factor explains 21.66 % of total variance and it was composed of four variables (related to thinking of gender equality in STEM, believing in equal STEM knowledge between genders, in equal success in STEM, inequality of women and men in STEM). The second question asked Generation Z what are the main obstacles for woman to compete with men in the STEM area. Using the factor analysis for the description of the results, Cronbach's alpha gave the result of 0.592, which discovered that the model could not be reliable and adequate. For that reason, the factor analysis was not proceeded, thus descriptive statistics was applied. The results revealed that the major obstacle in woman competition with men was their involvement in taking care of children and family. Next at a very high position comes gender discrimination and stereotypes of STEM being incompatible are for woman. Lack of aggression and confidence were also considered as an obstacle, but not so commonly mentioned as the previously stated ones. Finally, obstacle of women being not as physically prepared for working in STEM, as men, revealed being the least reliable as being a struggle in female competition with men.

The third question asked female respondents to determine main obstacles for woman to run company in technology area.

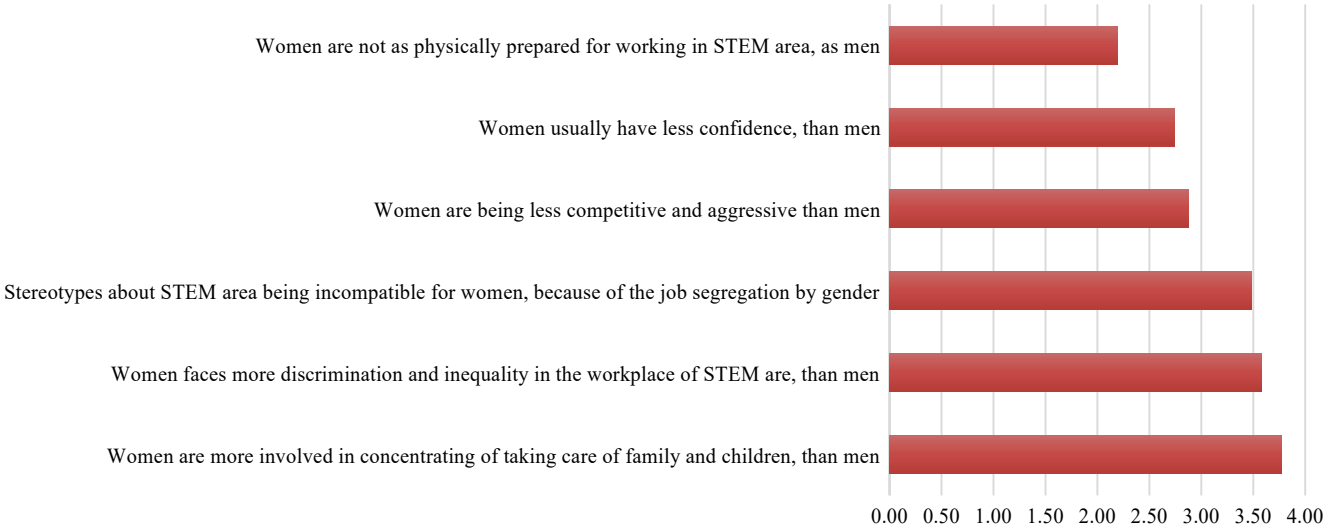

Figure 2: Main Obstacles for Women to Compete with Men in STEM

Testing the variables of this question, KMO test was 0.737, Cronbach's alpha was 0.754 and Bartlett's test was lower than 0.05; thus, these ratios showed that results were reliable and adequate. Correlation was also tested to be almost non-existing. It is seen that there are two main factors exposed (Table 4). Hence, the component matrix was needed to rotate by varimax rotation (Table 4 and Table 5), since the first factor was dominant to almost all variables.

Table 4: Component matrix

	Component	
	1	**2**
Emotions	0.641	-0.439
Lack of support	0.693	-0.310
Raising families	0.538	0.316
Fear to fail	0.717	-0.336
Less funding	0.724	0.310
Stereotypes	0.477	0.718

Table 5. Rotated component matrix

	Component	
	1	**2**
Emotions	0.775	
Lack of support	0.735	
Raising families		0.583
Fear to fail	0.770	
Less funding		0.694
Stereotypes		0.859

After the rotation, final results were stated and they mark that the first factor explained 40.78 % of total variance and it was composed of three variables (obstacles of women emotions, lack of support and fear to fail), while the second one explained 18.57 % of total variance and it was composed of three variables (the obstacle of raising families, stereotypes and getting less funding) as well.

Discussion and Conclusions

The study of scientific literature and other sources revealed that even with more women entering the work force, many developed countries still lack female presence in the fields of STEM. In countries, such as Lithuania, this trend might seem to be less present than in Germany or the United States. However, the study confirmed that young women are still haunted by various barriers and stereotypes preventing them from engaging in STEM or entrepreneurship. These results are in the line with Dicke et al., (2019). The majority of young women expressed willingness to pursue their career in STEM, as they believe in equal knowledge and equal possibility of success in those fields between genders. However, despite young women have aspiration and abilities to engage in STEM, not everyone intends to exploit this potential. Generation Z generally see themselves in the future as event planners, designers, social workers, teachers or customer representatives. Meanwhile, generations Y and X are more likely to participant in business and finances careers, working as managers, accountants or various analysts. Entrepreneurship leads in the selection of business area too. More than 50% of members of generations Z and Y are mostly willing to start their business in the areas of financial activities or business in general. Generation X tends to be more flexible. The main concern resulting the situation of women avoiding the areas of STEM and entrepreneurship is fear of possible obstacles they might face. Generation Z set forth the existing stereotypes and lack of support as the main barriers, while Generation Y specified gender discrimination and lack of aggression and confidence for women to compete with men. Generation X on their behalf points out career interference with high involvement in taking care of the children and family.

In conclusion, currently there are still difficulties preventing women from joining the area of STEM or creating their own business; thus, because of the various preexisting fears, it is quite complicated for them to overcome all those barriers and stereotypes. However, generational tendencies, way of thinking and various beliefs change. Females from the younger generations are now braver and more willing to engage themselves in technological areas of business and are demonstrating that with their abilities. Compared to their male counterpart, they are capable of success in the area of STEM, proving that the science doesn't have to have to gender bias.

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Conflict of Interest

There is no conflict of interest. The author has not received any external funding.

Authors' Biography

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