

MANAGING GENDER STEREOTYPES IN STEM AND ENHANCING VOCATIONAL EDUCATION FOR EMPLOYABILITY

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Abstract

The paper aims to examine the persistence of gender stereotypes in STEM education and identify opportunities to enhance the inclusivity and attractiveness of Vocational Education. The analytical part of the paper consists of quantitative and qualitative research. Through ordinal logistic regression, the determinants influencing female and male students' attitudes towards gender stereotypes and future careers in STEM fields are analysed. The qualitative part draws on focus group outputs to understand the challenges of this topic in greater depth. University students are more resistant to stereotypes than high school students. At the same time, men tend to believe in gender stereotypes more than women and nonbinary people. An important aspect is positive female role models, which eliminate this adverse persistent phenomenon and increase the inclusiveness of the learning environment for female students. University students are more likely to envision a future in STEM than high school students, and there were no statistically significant differences in the plans of male and female students. Non-binary students are more likely to choose a career in a different field.

Keywords: gender stereotypes, gender equality, education, vocational education

1. INTRODUCTION

Vocational education and training are an integral part of the education system that aims to provide students with practical skills and knowledge for their future careers. The skills acquired enhance their employability and support their personal development (European Commission, 2023). High-quality vocational programs may facilitate the transition from school to work and contribute to reducing early school leaving by providing students with the practical skills and knowledge needed to enter the economy. Such programs are an alternative route to academic education, enabling students to acquire the qualifications and expertise to progress in their careers and contribute effectively to economic prosperity (OECD, 2023). On the other hand, they contribute to improving the performance of enterprises, competitiveness and foster the development of innovation (Backes – Gellner and Lehnert, 2021). Within the European Union, VET is one of the areas of focus for cooperation under the European Education Area initiative between 2021 and 2030.

Specifically, VET places a significant emphasis on the management of vocational training to meet the swiftly evolving demands of the labour market and provide opportunities for young individuals. This flexibility is achieved through the regular updating of VET curricula and program offerings (European Commission, 2023). VET providers are granted a reasonable degree of autonomy to manage their offerings in response to shifting labour market requirements, including work-based learning components. The overarching goal of vocational training is to facilitate equal opportunities in education and employment, VET programmes are expected to be managed inclusively and made accessible through targeted measures aimed at promoting gender equality, eliminating disparities in professions traditionally associated with specific genders, and addressing gender stereotypes. (The council of the European Union, 2020). The European Union's Gender Equality Strategy 2020-2025 significantly addresses the issue of gender gaps in vocational education and training. It emphasizes the importance of VET programmes for both men and women, with the aim of achieving a better gender balance in professions that have historically shown a significant imbalance in favour of men or women (European commission, 2020). In many countries, VET is essential in integrating diverse groups of learners and achieving the goal of inclusive education for all different groups of students (Schmid and Garrels, 2022). Vocational Education and Training (VET) in STEM fields can sometimes be male-dominated, with a higher representation

of males in certain STEM-related professions and courses (STEM stands for Science, Technology, Engineering, and Mathematics). Gender imbalances in STEM fields can be influenced and perpetuated by deep-seated gender stereotypes, which might lead us to expect such disparities. Therefore, the question arises: What strategies and initiatives can be implemented to empower girls in STEM education and careers, while addressing and overcoming gender roles and stereotypes that may hinder their participation and success in male-dominated fields?

2. LITERATURE REVIEW

Gender stereotypes play an important role in shaping social norms, aspirations, and expectations, including the decisions that individuals make about educational choices. It can be assumed that the fields of study chosen by females are influenced by gender stereotypes and thus hide their predispositions to study and pursue careers in male-dominated fields and professions. Our aim is to shed light specifically on the case of vocational education and training (VET) schools that are oriented towards STEM (Science, Technology, Engineering, and Mathematics) fields. We will address the interaction of gender stereotypes, educational segregation, and the unique characteristics of STEM-focused VET schools to contribute to a deeper understanding of the dynamics that influence individuals' educational choices and, ultimately, their career trajectories.

2.1. *The power of gender stereotypes and educational segregation: Why do women choose fields of study "typical" of their gender?*

Stereotypes represent expectations about members of certain social groups; they do not say what members of groups are like but what they should be like. Although there are differences between groups, in the case of gender stereotypes – males and females – all individuals within groups may not differ in certain aspects. Stereotypical perceptions and their associated expectations lead people to exaggerate differences between groups and, in turn, downplay differences within groups (Ellemers, 2018). Consequently, gender stereotypes often create unrealistic and idealized images of femininity and masculinity, acting as role models in all areas of life. By adopting patterns of masculinity and femininity, stereotypes are created that homogenize the characteristics of the "real man and the real woman" (Jesenková, 2019). Stereotypes represent a steady state of a specific habit that is highly resistant to change (Haines, Deaux, and Lofaro, 2016). Gender stereotypes can have negative consequences for both men and women because they limit their choices, opportunities and well-being. In education, for example, gender stereotypes can affect students' academic performance, motivation and self-esteem. Typically, girls tend to underestimate their abilities and avoid subjects that are stereotypically masculine, such as math and science, while boys tend to overestimate their abilities and avoid subjects that are stereotypically feminine, such as languages and the arts. At work, gender stereotypes can significantly affect people's career aspirations, decisions and outcomes. Women face greater barriers and discrimination than men in male-dominated fields such as engineering and management, while men face greater stigma and prejudice than women in female-dominated fields such as nursing and teaching.

2.2. *What are the sources of gender stereotypes?*

Although we are familiar with the concept of stereotypes, the interesting question is how do these stereotypes arise? There are several theories, two of which figure prominently in the study of gender stereotype the Social Role Theory and the Stereotype Content Model (Morgenroth and Ryan, 2018). The social role theory, introduced by Alice Eagly in 1987, offers valuable insights into the genesis of gender stereotypes. This theory assumes that gender stereotypes arise from the division of labour in society, which assigns different roles and responsibilities to men and women. By primarily working in high positions, men wielded a great deal of power and held better-paid positions. Women, on the other hand, had a different position in society that was primarily related to caregiving, both within the family and in society (Ridgeway, 2001). These role-based differences, which are rooted in historical norms and expectations, continue to manifest themselves in various forms in most EU countries.

Moreover, the outbreak of the COVID-19 pandemic has brought some of these disparities to the surface, particularly in relation to unpaid caregiving responsibilities in households. The challenge of balancing work and

caring responsibilities disproportionately burdens women, further deepening the age-old problem of work-life balance. The unequal distribution of childcare and household tasks remains a prevalent problem. Childcare and household care remain unequally divided between men and women (EIGE, 2022).

In addition, the gender gap extends to decision-making and leadership, with women significantly under-represented in top management positions. However, the situation has been improving over the years, with changes occurring particularly in Member States that have binding gender equality legislation (EIGE, 2022).

Eagly's theory, based on the above, assumes that gender stereotypes stem from the fact that men and women are over and under-represented in different roles in society. By men being over-represented in decision-making positions, the behaviours and characteristics for holding these positions become part of male gender roles. Conversely, women become part of the caring gender role. This theory only looks at the physical dissimilarities between men and women and does not consider any psychological differences (Morgenroth and Ryan, 2018). Later, Fiske and colleagues (2002) formulated a Stereotype content model that equally addresses the origins of particular sets of characteristics that are subsequently attributed to particular social groups (Eckes, 2002). Furthermore, they posit that gender stereotypes originate from prevailing societal constructs; however, his theoretical framework extends its applicability beyond merely the male-female binary to encompass various demographic groups (Morgenroth and Ryan, 2018). This inclusive perspective emphasizes that stereotypes can influence not only the perceptions and roles of men and women, but also other individuals from different ethnic, cultural, and socioeconomic backgrounds. The model assumes that the core dimensions of stereotypes are competence and cordiality, with competence being associated with success in tasks to which high social status is attributed and cordiality, defining a group's socio-emotional characteristics towards others. Stereotypes, meanwhile, contain a combination of these two dimensions, and these dimensions are unbalanced. For example, traditional female subgroups are characterized as cordial but not competent in line with paternalistic stereotypes (Eckes, 2002).

Conversely, women in non-traditional roles are often perceived as competent but not very cordial. They are also commonly perceived as assertive and confident. The mixed combinations of competence and cordiality create a quadruple taxonomy in which the subgroups are perceived differently according to their characteristics. They may be admired by the environment (a combination of high cordiality and high competence) or discriminated against (a combination of low competence and low cordiality). The content of stereotypes is also contingent upon the interdependence and social status of various groups. This means that high-status groups are attributed characteristics associated with their high competence and vice versa. At the same time, interdependence can be cooperative or competitive, which influences the perception of the level of the cordiality of the groups in question (Eckes, 2002).

2.3. What impact gender stereotypes have on women's and men's educational choices

Gender stereotypes and gender roles shape perceptions of men and women in society. These notions are reflected in everyday life in various forms, one of which is the very educational choices of men and women. How do societally constructed expectations influence educational choices, and what impact do they have on the career trajectories of both men and women?

In the European Union, women outnumber men in terms of tertiary education attainment (Eurostat, 2023), and the choice of field of study is therefore seen as a primary instrument through which education can influence women's employment in particular sectors of the labour market, thus ultimately mitigating or exacerbating occupational segregation or the gender wage gap. Research across the EU-15 has shown that more significant differentiation in fields of study translates into employment approximately three years later (Emerek, 2008). According to 2019 European Commission research, up to 75% of men in the European Union chose a field of study related to engineering, construction, and manufacturing. At the same time, men also dominated in fields such as science, mathematics, statistics and IT (STEM) (Dijstra, Papadimitriou and Norlém, 2019).

Conversely, more than 75% of women chose education as their field of study, with almost two-thirds studying humanities and more than 70% studying social care at university (Dijstra, Papadimitriou and Norlém, 2019). Where do these preferences stem from? Are they the free choice of each student, or are they burdened by the weight of gender stereotypes and roles?

In this context, individuals often experience what is commonly referred to as the "Frog Pond Effect". For instance, when students excel in science-related subjects, it heightens their probability of pursuing further studies in social sciences or humanities, and vice versa (Dryler, 1999). The overrepresentation of women in programs such as social work or nursing can be attributed to societal stereotypes that perceive women as naturally predisposed to caregiving roles (Bradley, 2000).

However, as Barone (2011) argues, gender stereotypes also have a 'more subtle' impact on women's preferences, particularly when influencing their contingency plans, often referred to as 'Plan B'. Imagine a female student studying history, but this field may have labour market problems, and the student ends up working as a teacher; studying other humanities disciplines may have a similar outcome. In other words, only some disciplines have a well-defined career path, and graduates only sometimes get jobs 100% relevant to their education. However, social stereotypes may make it acceptable for women to work in this field, whereas men might see teaching as a low-paid and typically female job and refuse to accept this as a Plan B option.

This article focuses on the study of technical disciplines. Are girls counting on a "Plan B"? What are their career goals after graduating with a technical degree? Do they want to continue working in STEM fields, or have their career aspirations changed during their studies?

2.4. *What is the situation of VET in Slovakia?*

The article focuses its attention on the examination of technical disciplines within the Vocational Education and Training (VET) and higher education environment in Košice. The main aim of the research is to find out if female students have a "Plan B" in mind at the beginning of their educational journey. Specifically, we seek to uncover their career goals after completing their technical studies. Do they aspire to continue their studies within STEM fields or have their career aspirations changed during their studies? In particular, the research aims to clarify the possible persistence of gender stereotypes and unconscious prejudices. These elements may not only strongly influence the different attitudes of male and female students regarding the attractiveness and inclusiveness of these institutions but may also significantly affect their career aspirations in STEM fields.

In the context of vocational education and training (VET) in Slovakia, various authors have addressed this multifaceted topic from different perspectives. Černáková (2018), underlines that the interests of both parents and pupils are predominantly inclined towards secondary schools ending with a high school diploma. On the other hand, these educational choices may not be consistently aligned with the actual demands and requirements of the labour market.

Vocational education in Slovakia has undergone a transformation that has reduced the number of secondary schools by about 37%. Optimising the secondary school network aims to achieve consistency between demographic development and labour market requirements. The Slovak Republic seeks to apply standardization, which links the aims and objectives of vocational education in European countries (Černáková, 2018). In these countries, and Slovakia too, quality assurance of education is an essential part of modernizing education and training, increasing its performance and attractiveness. VET should not only include new challenges in terms of the labour market and skills needed but also in terms of inclusion (Hrmo, Kristofiaková and Miština, 2015). However, in vocational schools, there is not yet a system that assesses the quality of vocational education; student performance is assessed, but this can be seen as a one-sided assessment that does not present the topic comprehensively (Podařil, 2013).

The article intends to expand the current level of knowledge in the field of VET education in Slovakia and to focus on the possible persistence of gender stereotypes and unconscious biases that may not only affect the different attitudes of male and female students to the attractiveness and inclusiveness of these schools but may also negatively or positively affect their career aspirations within the STEM sphere.

3. METHODOLOGY

The main aim of this article is to shed light on the persistent impact of gender stereotypes and roles, by examining the perspectives of male and female students studying for technical degree programmes in universities and vocational schools. Embedded gender expectations can have a detrimental impact not only on women but also on men. Students may feel pressured by the need to represent themselves in terms of traditional masculine qualities such as decisiveness, competitiveness, self-confidence and skill in technical

fields, which may ultimately narrow their career options to fields of study and, subsequently, employment that is perceived as typically masculine (Makarova, Arschlimann and Herzog, 2019). On the other hand, through the lens of gender stereotypes, women may be perceived as more likely to excel in social fields, and their career choices should consider their responsibilities within the family and household. This may lower their self-confidence but will result in a lack of female role models in this area who may motivate young girls to choose a similar career path. Female students may feel discriminated against in this environment, which will negatively affect the inclusivity of the environment, and stereotypes may also, as in the case of male students, manifest themselves in the form of limited career options (Master, Meltzoff and Cheryan, 2021).

The article's theoretical part focuses on analysing gender stereotypes and their impact on the educational segregation of male and female students. It examines the possible reasons for the emergence of gender stereotypes in this area and their impact on educational choices. The analytical part of the article consists of quantitative and qualitative research to find possible patterns and then zoom in on the phenomenon under study.

3.1. Quantitative research

The analysis of the quantitative part of the paper draws upon data collected through a comprehensive questionnaire, which consists of 372 responses from students of the Faculty of Civil Engineering of the Technical University in Košice and students of the Secondary Industrial School of Civil Engineering and Geodesy in Košice. The sample exhibits a nearly balanced distribution between high school (50.27%) and college (49.73%) students, ensuring a representative mix of educational backgrounds. In addition, the gender composition of the sample is also very balanced, as 48.92% of the students were female and 49.46% were male. A small but significant group consisting of six students (1.61%) identified themselves as non-binary or belonging to a different gender category. Given the importance of inclusivity in our research, we intentionally kept this demographic segment to also consider their perspectives on the main research questions of the study.

The survey had an anonymous format and included a combination of closed and open-ended questions that encouraged students to provide detailed information about their perspectives.

However, in Vocational Education and Training (VET), researchers often encounter considerable difficulties in obtaining internationally comparable data. Therefore, our article focuses exclusively on the Slovak Republic. In contrast to general education, VET programs lack comprehensive international benchmarks, which limits the ability of countries to assess their performance in this area and hampers the potential for cross-border knowledge exchange and the adoption of best practices (OECD, 2023).

The core of our quantitative analysis comprises the development of three econometric models using the ordinal regression method. Ordinal logistic regression is a statistical technique used when the dependent variable we are trying to explain is ordinal in nature. Ordinal variables have levels with a reasonable order, and the intervals between categories need not be equidistant or measurable. The scale scores on questionnaires are typically ordinal variables. The goal of ordinal regression is to model and predict the relationship between an ordinal dependent variable and several independent variables (factors). The independent variables can be both continuous and categorical variables.

The logistic function transforms the linear combination of predictors into probabilities for each ordinal category. Ordinal regression provides coefficients for each predictor variable that indicate the strength and direction of their influence on the probability of moving into a higher or lower ordinal category. Let Y be the ordinal dependent variable, taking values from 1 to J and X_1, X_2, \dots, X_p are the independent variables (predictors). $P(Y \leq j)$ is the probability that Y , an ordinal response variable with J categories, is less than or equal to j : $P(Y \leq j) = F(\alpha_j - \beta_1 X_1 - \beta_2 X_2 - \dots - \beta_p X_p)$.

The parameters $\alpha_j, \beta_1, \beta_2, \dots, \beta_p$ are estimated by fitting a cumulative logit model to the data. We have constructed three distinct ordinal logistic regression models:

- Students' attitudes towards gender stereotypes,

- Assessing students' attitudes toward inclusivity and attractiveness of education in the sustainable energy sector for women,
- Students' attitudes towards their future STEM careers.

3.1.1 Gender stereotypes

The first model the factors influencing students' attitudes, regardless of gender, towards gender stereotypes. Specifically, it examines students' attitudes regarding the assertion that male students are inherently more proficient in STEM subjects than female students. Table 1 lists the variables examined along with their anticipated impact on the dependent variable.

TABLE 1 – VARIABLES USED IN THE ECONOMETRIC MODEL ANALYSING GENDER STEREOTYPES

Variable	Name of variable	Unit of measurement	Expected impact
Men perform better in STEM subjects	gender stereotypes	1-definitely no, I don't think so-2, I don't know-3, definitely yes- 4	X
Gender	gender	1- men, 2- women, 3 - other	-
Education level	education	1- secondary school, 2- tertiary education	-
Contact with female leaders in STEM (teachers, in text books...)	role models	1-never,2- few times, 3-sometimes, 4-very often	-

The ordinal regression equation is as follows:

$$\text{Gender stereotypes} = B_0 + B_1\text{gender} + B_2\text{education} + B_3\text{role models}$$

We make several assumptions regarding the econometric model:

- We hypothesize a negative relationship between gender stereotypes and respondents' gender. We expect that men will primarily agree with this statement since, in the context of educational segregation or gender roles, technical skills and logical thinking are more likely to be attributed to men than to women (Makarova, Arschlimann and Herzog, 2019),
- We hypothesize a negative relationship between gender stereotypes and respondents' education. We expect college students to be more resistant to gender stereotypes, which may be associated with higher education and the development of critical thinking.
- We predict that students who meet female role models, whether female teachers, well-known figures in the Tech field, or other role models, will be less prone to claim that men are naturally better at technical subjects. Role models are essential for female students who are motivated by the fact that they too can succeed in the field (Corneliussen, 2021). Stereotypical and gender-biased textbooks that lack female role models also contribute to gender inequality (Acker and Oatley, 1993).

3.1.2 Assessing students' attitudes toward inclusivity and attractiveness of education in the sustainable energy sector for women

The second model analyses the determinants of students' attitudes, both male and female, regarding inclusivity and attractiveness of education in the field of sustainable energy for women. Table 2 lists the variables examined and their expected impact on the dependent variable.

The ordinal regression equation is as follows:

$$\text{SE education inclusive women} = B_0 + B_1\text{gender} + B_2\text{education} + B_3\text{role models} + B_4\text{gender stereotypes} + B_5\text{environment inclusiveness} + B_6\text{discrimination}$$

Assumptions of the econometric model are:

- We assume that education in sustainable energy will be considered inclusive for women by men rather than women. We assume that women may have non-transferable experiences that men cannot

empathize with. At the same time, by stereotyping gender roles, they may not be susceptible to perceived discriminatory practices against female students.

- We hypothesize that education in sustainable energy will be considered inclusive for women by university students rather than secondary school students. The college offers a greater variety of degree programs and electives where women and men can choose the field or area of study that interests them most. College offers more options than high school, making education more inclusive in this range.
- We hypothesize that if students are exposed to female role models more often, they will perceive education in this area as more inclusive for women. Women who have succeeded in this field open doors for other female students, thus mitigating persistent gender stereotypes and motivating female students to pursue careers in this field.
- We hypothesize that students who perceive male students to be inherently better in technical fields perceive education in this field to be less inclusive and attractive to women, as its content is primarily technically based subjects in which these assumptions suggest women may have difficulty.
- We hypothesize that students who perceive the STEM environment as discriminatory and not inclusive enough will also perceive education in this field as less inclusive and attractive for women.

TABLE 2 – VARIABLES USED IN THE ECONOMETRIC MODEL ANALYSING STUDENTS' ATTITUDES TOWARD INCLUSIVITY AND ATTRACTIVENESS OF EDUCATION IN THE SUSTAINABLE ENERGY SECTOR FOR WOMEN

Variable	Name of variable	Unit of measurement	Expected impact
Education in the sustainable energy sector is inclusive and attractive to women	SE education inclusive women	1-definitely no, 2- I don't know, 3- neither yes nor no, 4- definitely yes	X
Gender	gender	1- men, 2- women, 3 - other	-
Education level	education	1- secondary school, 2- tertiary education	+
Contact with female leaders in STEM (teachers, in textbooks,)	role models	1-never,2- few times, 3- sometimes, 4-very often	+
Men perform better in STEM subjects	gender stereotypes	1-definitely no, I don't think so- 2, I don't know-3, definitely yes- 4	-
VET environment in the STEM field discriminatory and not inclusive enough	environment inclusiveness	1-definitely no, 2- I don't know, 3- neither yes nor no, 4- definitely yes	-
Experience of discrimination	discrimination	no- 1, yes – 2	-

3.1.3 Students' attitudes towards their future STEM careers

The third model examines whether students from technical university and high school students plan to pursue STEM careers and identifies the key factors influencing their decision-making. Table 3 lists the variables examined and their anticipated impact on the dependent variable.

The ordinal regression equation is as follows:

$$\begin{aligned} \text{Future STEM} = & B_0 + B_1 \text{gender} + B_2 \text{education} + B_3 \text{role models} + B_4 \text{gender stereotypes} \\ & + B_5 \text{environment inclusiveness} + B_6 \text{discrimination} \\ & + B_7 \text{public places women needs} \end{aligned}$$

We make several predictions regarding the econometric equation:

- We predict that men than women are more likely to plan their careers in STEM after completing technical education. In doing so, we draw on the arguments of Baron (2011), who discusses the influence of gender stereotypes and roles on women's choice of career paths, manifested in the choice of a 'Plan B'. In this case, Plan B for women may be, for example, a career as a teacher of technical subjects.

TABLE 3 – VARIABLES USED IN THE ECONOMETRIC MODEL ANALYSING STUDENTS' FUTURE CAREER IN STEM

Variable	Name of variable	Unit of measurement	Expected impact
Future career in the STEM field	future STEM	1. I don't want to work in STEM - don't feel good in this field, 2- I don't want to work in STEM - the field is only suitable for people who are good enough at it, 3- I don't want to work in STEM - the field is not compatible with family life, 4- I don't want to work in STEM- it is not the field for me, 5- I want to work in STEM- I will try to succeed, 6. I want to work in STEM - the field allows for a full professional realization	X
Gender	gender	1– men, 2- women, 3 – nonbinary and other	-
Education level	education	1- secondary school, 2- tertiary education	+
Contact with female leaders in STEM (teachers, in textbooks,...)	Role models	Dummy variable (1-never, 2- few times, 3- sometimes, 4-very often)	+
Men perform better in STEM subjects	Gender stereotypes	1-definitely no, 2- I don't think so, 3- I don't know, 4-definitely yes	undefined
Education environment in the STEM field discriminatory and not inclusive enough	Environment inclusiveness	1-definitely no, 2- I don't know, 3- Neither yes nor no, 4- definitely yes	-
Experience of discrimination	Discrimination	no- 1, yes – 2	-
Public and shared spaces should be more responsive to women's needs	Public places women needs	1-definitely no, 2- I don't know, 3- Neither yes nor no, 4- definitely yes	-

- We assume that college students are more likely to plan for a future in STEM fields than high school students. In tertiary technical education, college students can acquire basic knowledge in a wide range of fields within their chosen program of study. They have a greater insight into the opportunities that the STEM field offers and in which they could, but more importantly, would like to pursue a career. VET education provides students with the opportunity for employment after high school. However, we assume that a group of students will be interested in continuing their education at university and that these students do not consider a career in a STEM field to the same extent as university students.
- We hypothesize that exposure to female role models in the STEM field will positively influence female students' aspirations for careers in the field. Female role models help eliminate gender roles and stereotypes associated with STEM fields and can motivate and encourage female students to pursue careers. They also show female students that they can be successful in the field.
- Gender stereotypes can have a differential impact on male and female students. Identifying with gender stereotypes, in this case, the assertion that male students naturally perform better in technical subjects may motivate male students to choose a career in a STEM field as they may perceive this as the most appropriate choice given their natural abilities and endowments associated with gender stereotypes, i.e., better logic, analytical thinking, decisiveness, technical skills. Conversely, the same gender stereotypes and assertions may discourage women who believe them from pursuing a career in this field. Influenced by gender roles, they may perceive that a better choice for them is a more 'traditional job' linked to their stereotypically given qualities such as a sense of caring, helpfulness, and child-rearing.

- We hypothesize that students who perceive the educational environment in STEM fields to be less inclusive and discriminatory will be less interested in pursuing this field after their education.
- We hypothesize that students who have experienced discrimination related to their educational choice, whomever the recipient, will be less inclined to pursue a career in this field.
- We hypothesize that students, primarily women who perceive that public spaces and common areas should be more responsive to women's needs, may feel that this is similar in the work sphere. This may cause them to distance themselves from the field and choose a different focus after completing their technical education.

3.2. Quantitative research

The qualitative research employs the focus group method, that collects data based on participant communication. This form of research differs from interviews in that it obtains information from the interaction between participants. This method promotes the sharing of respondents' experiences and a more detailed description of the phenomena under study, justifying their effects and revealing dimensions that are difficult to identify through other methods. As the group studied were students, another advantage of choosing this method is that it can encourage contributions from those people who feel they have nothing to say, as well as those who would be reluctant to take part in an individual interview (Kitzinger, 1995).

Four female and four men students from the Secondary Industrial School in Košice participated in the interview. The focus group aimed to reveal students' attitudes towards the inclusiveness and attractiveness of their field of study and to find out what could contribute to increasing these two aspects from their point of view. Additional open-ended questions explored the role of role models for female students, the persistence of gender stereotypes and prejudices, the experience of discrimination, and possible ways to prevent it.

The focus group was conducted in the following structure and aimed to answer the following questions:

Gender roles and stereotypes:

- When learning (in textbooks or the classroom), do you encounter outstanding personalities (role models), such as women or people of different skin colours?
- Do male students perform better than females in science, engineering and maths subjects?
- Were you afraid of technical fields as a woman? What made you choose this field of study?
- How do male students perceive their female classmates and their decision to study at a technical school?

Attractiveness and inclusion of VET education:

- Do you have foreign students, students from Roma minorities or students from the LGBTI+ community at your school?
- From your point of view, what would help to increase the attractiveness of this school?
- How could discrimination be prevented?

4. RESULTS

This article focuses on the analysis of vocational education in the technical field. The representation of students of VET has decreased significantly since 2017. One of the undeniable reasons for this is the demographic development itself. Slovakia and other countries have an ageing population and a declining group of secondary school students (Černáková, 2018). However, the share of women students has been increasing over the years (22% in 2021). It is important to note that the number of girls has increased only minimally. A critical phenomenon has been the significant reduction in male students.

In the case of tertiary education, an opposing phenomenon has occurred in recent years: an increase in male undergraduate students in ICT, engineering, manufacturing and construction. However, the representation of

women in these fields is also increasing. In the last year under review, the representation of women in this field of education was 14.5 %.

National statistics for secondary and tertiary education show a significant gender gap. The question remains: What is behind these differences? Do women feel accepted in the technical field? Are students vulnerable to gender stereotypes?

4.1. Determinants of student's attitudes towards gender stereotypes

The first econometric model examines the determinants of students' attitudes towards gender stereotypes. The presence of gender stereotypes among high school and college students was analysed using a case study. Students responded to a question asking whether male students naturally perform better in STEM subjects.

Three independent variables were analysed: gender, education, and role models, which are statistically significant. Within gender, females and non-binary individuals were shown to be less prone to gender stereotypes. Although non-binary persons in our sample are tiny, the results show a 2.5 times higher chance that this vulnerable group disagrees with the above statement. Women are 1.3 times more likely compared to men. Female students studying in technical schools do not identify with established gender stereotypes in this area. To a greater extent, these statements are believed by men, who may be motivated by them, affirming the correctness of their educational choices or boosting their confidence in their skills.

Regarding education, secondary school students tend to be more likely to believe stereotypes than university students. Younger students may be more subject to social pressures from family, relatives or society. As they get older, this pressure may slowly fade from their lives. Female undergraduates studying in technical fields may become more aware of their strengths, and success at university in this field helps them to build their self-confidence and realise their worth. At the same time, in terms of inclusion, the university is more diverse regarding the participation of different groups of students. Lastly, higher education is associated with developing critical thinking and awareness of different forms of discrimination, which can positively influence their attitudes towards gender stereotypes.

Role models are also a statistically significant in shaping students' attitudes towards gender stereotypes. Students who encounter women to a greater extent in STEM fields, whether in job materials, textbooks, or at school, tend to be less gender stereotyped. Positive female role models can encourage and motivate female students to pursue their ambitions; in turn, they can positively influence male students who, as a result, realise that women, not just men, can be successful in the field. Table 1 lists the variables examined and their impact on the dependent variable.

TABLE 4 – GENDER STEREOTYPES – RSTUDIO OUTPUTS

Variable	Value	p – value
factor(gender)2	-1,32456	1,54346e ⁻¹⁰ ***
factor(gender)3	-2,55226	0,00067 ***
factor(education)2	-0,75137	0,00219 ***
factor(role models)2	-1,21298	0,00732 **
factor(role models)3	-1,16510	0,00944 **
factor(role models)4	-1,10401	0,01930 *

Note: meaning of stars: +p<0.1, *p<0.05, **p<0.01, ***p<0.001

4.1.1 Insight from the focus group

A similar question was addressed in qualitative research through focus groups. Although the sample size is small, most male students disagreed with gender stereotypes in a joint discussion with female students. From their point of view, success in technical subjects is individual. They mentioned they know female students with well-developed logical thinking, mainly associated with males, but also males who are gifted in other areas. However, this view was not held by all participants.

Concerning stereotypes and prejudice, female students in the Focus Group admitted that they face prejudice and stereotypes mainly from those closest to them. Female students faced ridicule from family members or parents' fears that they could not cope with a technically oriented school. They were encouraged to choose a field of study perceived as "typically female". Stereotypical perceptions of the Secondary Industrial School can

also be problematic. People associate the school with bricklaying, which is perceived differently by the public as an attractive occupation. It may be necessary to inform them about the possible fields that can be studied and possible employment opportunities after graduation. Despite obstacles from those closest to them, the students opted for technical education and have not regretted their decision.

In most cases, their passion for drawing and ambition to become an architect led them to this decision. The students agree and perceive that their female classmates are more inclined towards design-oriented subjects. Nevertheless, they believe anyone can learn anything if they have enough motivation and desire to study. The disciplines are open to both genders depending on individuals' preferences.

4.2. Vocational education in the sustainable energy sector being inclusive and attractive to women

Another econometric model examines the determinants of students' attitudes towards the inclusiveness and attractiveness of VET education in sustainable energy for women. What do students' attitudes depend on?

We hypothesized that attitudes towards inclusiveness and attractiveness are influenced not only by a student's gender and education but also by their attitudes towards gender stereotypes, role models and experience of discrimination. Based on the results, we can consider two variables to be statistically significant, namely gender and role models. We observed a significant change in attitudes in a small group of non-binary students, whose tendency to believe that the VET environment is attractive for women is 14 times higher compared to men. Our predictions were not fulfilled; the differences in attitudes between men and women are not statistically significant. At the same time, 15.3% of female students do not consider this sector to be inclusive and attractive. Our second assumption has been fulfilled. The results of Model 2 showed that when students encounter positive female role models in the school system, they subsequently perceive the environment as more inclusive and attractive to female students. Role models are a topic that many academics have addressed. For example, Volman and Eck (2001) advocate that not only is it important for female teachers to participate in teaching technical subjects, but the presence of female role models with sufficient skills and positive attitudes is also vital for enhancing girls' participation. Table 2 lists the variables examined and their impact on the dependent variable.

TABLE 5 – VET INCLUSIVE AND ATTRACTIVE TO WOMEN – RSTUDIO OUTPUTS

Variable	Value	p – value
factor(gender)2	0,31745	0,14345
factor(gender)3	14,90310	0 ***
factor(education)2	-0,02654	0,90234
factor(role models)2	0,97862	0,03726 *
factor(role models)3	1,07153	0,02234 *
factor(role models)4	0,95054	0,05099 +
factor(gender stereotypes)2	0,29006	0,32411
factor(gender stereotypes)3	-0,32952	0,31145
factor(gender stereotypes)4	0,28365	0,44696
factor(environment inclusiveness)2	-0,31282	0,32721
factor(environment inclusiveness)3	0,48495	0,08909 +
factor(environment inclusiveness)4	0,40125	0,21224
factor(discrimination)2	-0,24713	0,27966

Note: meaning of stars: +p<0.1, *p<0.05, **p<0.01, ***p<0.001

In the focus group, attitudes towards the LGBT+ community, not towards women, emerged as a problem with inclusion. These students, in the words of their classmates, face inappropriate comments from teachers because of their sexual orientation, different appearance, and form of presentation. In the focus groups as well as in the questionnaires, we also touched upon the topic of attractiveness. We were interested in what, from their point of view, could increase the attractiveness of this education not only for the group of women but also for ethnic minorities, students of different sexual orientation and other vulnerable groups.

What would help to increase the attractiveness of VET school?

Student responses from the questionnaire survey in relation to increasing the attractiveness of vocational education are similar to the views of students in the focus group. But the focus group discussion helped to uncover what could not be identified in sufficient depth through the questionnaire. From the students' point of

view, two key factors contribute significantly to increasing the school's attractiveness and inclusiveness: the teaching's attractiveness, relevance, and the need to modernise the school premises. Students would prefer teaching that focuses on applying practical skills and abilities. The curriculum needs to be updated in their view and reflect the labour market requirements. Students consider continuous teacher training in the technical field and teaching methods critical factors in increasing the school's attractiveness. New fields of study and more internships would increase the school's attractiveness. Students rate their potential employment opportunities after graduating from high school differently.

Students do not have a strong preference for the gender of the teacher. They would prefer to have the opportunity to have people from practice lecturing at the school. They would accept consultations with career counsellors who could guide and motivate them to further studies. They would be interested in lectures, workshops or discussions that could better prepare them to enter the labour market.

Students feel that the way the school presents itself externally needs to reflect its functioning. They do not feel comfortable at school, an environment where they do not feel accepted by the teachers, and there is discrimination. They would accept regular anonymous teacher evaluations. There are also teachers with whom they can talk openly, but there are very few.

In other words, the attractiveness of the secondary school from the students' point of view would be increased by innovative teaching methods, changing the content of the curriculum, focusing on practice, and modernising the school classrooms and facilities. They would like to undergo targeted work experience, be educated on entering the labour market, and discuss their future career direction with career coaches. Students perceive a discrepancy between how the school presents itself externally to the public and how it operates.

4.3. Future in STEM

The last econometric model examined student attitudes toward STEM careers. Figure 1 reveals that nearly half of students plan to pursue a career in STEM because of the full realization it allows; another fifth of respondents view the field as one where they can succeed no matter who they are. The remaining 30% of students are not currently interested in STEM careers for a variety of reasons, but mainly because they have realized that the field is simply not right for them.

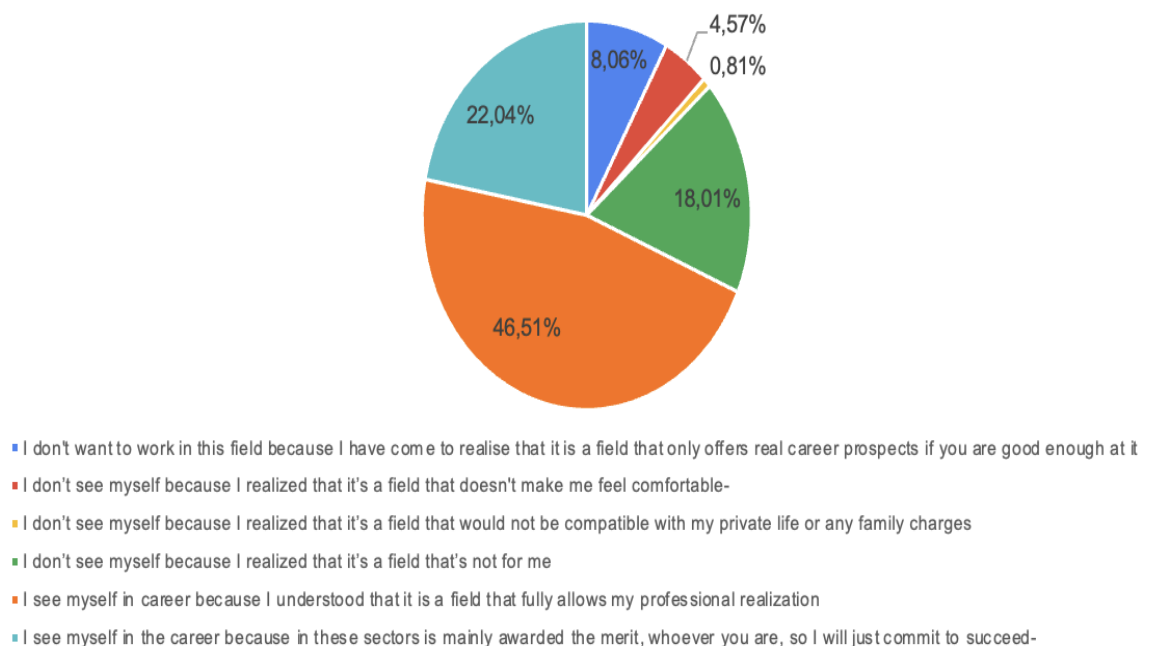


FIGURE 1 -ARE STUDENTS PLANNING CAREERS IN STEM FIELDS?

Source: based on information from the questionnaire

The econometric model included multiple independent variables of gender, education, role models, gender stereotypes, inclusiveness and attractiveness of the sustainable energy environment, a variable analysing students' attitudes towards considering women's needs in public and shared spaces, and experience of discrimination. Students' gender and level of education can be considered statistically significant. The stated assumption related to the fact that under pressure of gender roles and stereotypes, women would be more likely to choose careers other than in STEM was not confirmed. However, non-binary students were shown to be 1.16 times more likely to not pursue a career in a STEM field compared to males.

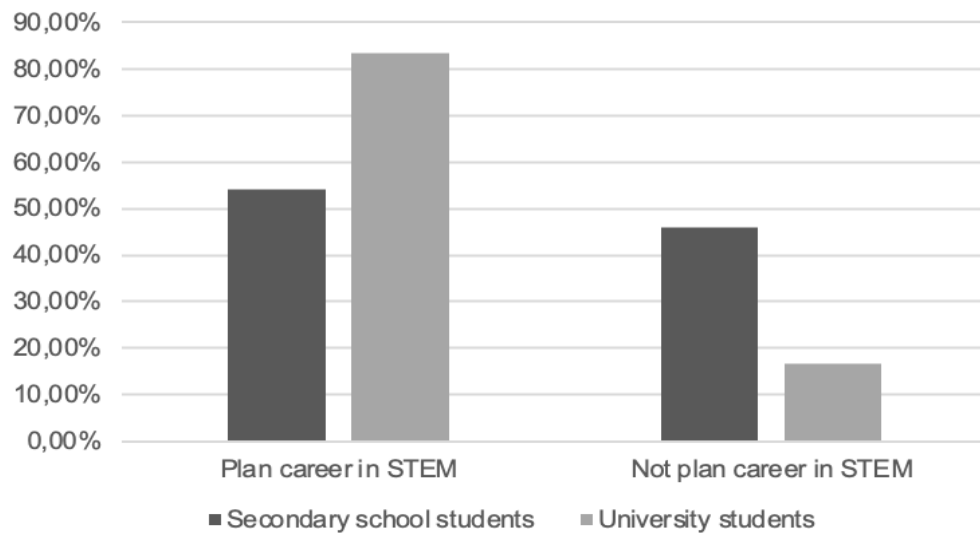


FIGURE 2 -CAREER IN STEM

Source: based on information from the questionnaire

The second significant factor was education, where it was shown that university students were more likely to choose a career in STEM than high school students. These findings can be clearly seen in Figure 2, where more than 80% of college students count on a STEM career. We hypothesize that this result is due to the fact that college students have a better idea of what the STEM field entails, they are more aware of their options in the field and realize its diversity, and, equally important, they may have had positive work experiences alongside school that reinforce the rightness of their decision. Table 3 lists the variables examined and their impact on the dependent variable.

TABLE 6 – FUTURE CAREER IN STEM – RSTUDIO OUTPUTS

Variable	Value	p – value
factor(gender)2	-0,13089	0,54272
factor(gender)3	-3,67928	0,00038 ***
factor(education)2	1,16392	2,197423e-07***
factor(role models)2	-0,01423	0,97435
factor(role models)3	0,09669	0,82894
factor(role models)4	0,22139	0,63279
factor(gender stereotypes)2	-0,30048	0,33129
factor(gender stereotypes)3	-0,59195	0,07914 +
factor(gender stereotypes)4	-0,44895	0,23951
factor(environment inclusiveness)2	0,13127	0,67078
factor(environment inclusiveness)3	-0,09432	0,73764
factor(environment inclusiveness)4	-0,20092	0,52189
factor(discrimination)2	-0,18207	0,41071
factor(public places women needs)2	-0,34546	0,48218
factor(public places women needs)3	-0,12057	0,75043
factor(public places women needs)4	-0,31889	0,37077

Note: meaning of stars: +p<0.1, *p<0.05, **p<0.01, ***p<0.001

5. CONCLUSIONS

Gender stereotypes and gender roles shape the choices men and women make throughout their lives. They influence young men's and women's career aspirations from an early age (Bian, Leslie and Cimpian, 2017). This article aimed to analyse the attitudes of male and female students in VET schools and technical colleges towards persistent gender stereotypes, discrimination, female positive role models or inclusiveness and attractiveness of this education not only for the majority group of students but also for vulnerable groups, primarily women.

The study reveals that young male students are more susceptible to gender stereotypes compared to females and non-binary individuals. On one hand, reinforcing the perception that males are inherently better at technical subjects may boost their aspirations to pursue careers in these fields, leading them to believe in an innate predisposition for STEM careers. On the other hand, these stereotypes may negatively affect not only women who perceive that their starting line is set back compared to men but also men who want to pursue careers in a non-"typically male" job sector. Stereotyping in this way can subtly shape students' decisions, whether concerning their education or careers in the field. Regarding education, university students are less influenced by gender stereotypes. Positive female role models contribute to the elimination of gender stereotypes by proving that women can succeed even in a sector that is often perceived by society as masculine. The presence of female role models also contributes positively to making sustainable energy education more inclusive and appealing to women.

The different expectations of male and female students for their STEM careers were also explored. We hypothesised that men would be the primary ones to choose a similar pathway after graduation. It turned out that the differences between men and women in this area were not statistically significant. Non-binary individuals have a higher tendency to choose a different orientation. Students' career plans differ depending on their educational background. While more than 80% of college students plan to pursue a career in STEM, about half do so in high school. For high school students, this question may not be as relevant as it is for college students. If high school students plan to go on to college, they still have plenty of time to decide. College students have a broader range of options in their technical studies to choose specific areas of interest through electives, to have hands-on experience, to have a greater understanding of what working in the industry entails, and to have a better understanding of what opportunities are available to them in the labour market. Our research indicates that VET students also desire access to similar opportunities, which would enhance the attractiveness of VET in their perspective.

In conclusion, we feel it is essential to emphasise the need for positive female role models, which, in several respects, are important in eliminating persistent gender stereotypes and students' perceptions of the inclusivity of the learning environment. Secondary and higher education institutions should not only be inclusive but also attractive. Innovative ways of teaching, changes in content to reflect technological and labour market shifts, and targeted vocational practice or training for entry into the labour market are factors that students perceive as key in making this type of education more attractive.

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