



## Research Article

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Received: 11 December 2022 / Accepted: 17 February 2023 / Published: 5 March 2023

# Gender Stereotypes and Women Participation in STEM Fields in the Western Balkans: A Scoping Review

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DOI: <https://doi.org/10.36941/ajis-2023-0044>

## Abstract

*The prevalence of gender stereotypes in STEM fields is evidenced by a large body of literature across the world, however, this area of research is still understudied in the Western Balkan region. To get a better knowledge of the extent of studies addressing this topic, we conducted a scoping review investigating existing gender stereotypes and educational choices in STEM in that region. As expected, the number of studies discovered was very limited, despite our generous inclusion criteria. In these limited studies, however, we found ample evidence of existing gender stereotypes in STEM and their impact on career aspirations. As this scoping review focused only on high-school university students, we conclude the paper with thoughts on future work ideas to expand the target group as well as to use systems thinking as an overarching perspective to conduct a holistic examination. This could be achieved by including relevant actors within and outside the immediate context, such as parents, schools, policymakers, businesses, and organizations. Finally, the paper also discusses the impact and opportunities that come with digitalization efforts, which could be leveraged to increase women participation in STEM.*

**Keywords:** STEM, gender, women, stereotypes, Western Balkans, digitalization

## 1. Introduction

Globally, STEM jobs have been on the rise and STEM workers are exhibiting better labor market outcomes than those working in other occupations (Hammond et al., 2020). However, the STEM field graduates are not matched with the increased demand for STEM professionals. Data on STEM degree

graduates from 143 countries show that the overall STEM share of higher education graduates has decreased from 34.88% in 1998 to 22.44% in 2018 (Lee et al., 2021). The general shortage of STEM graduates is also gender nuanced with women still being underrepresented among STEM degree holders. While women enrollment and graduation at the tertiary levels exceed that of men, globally, women have low representation in some STEM fields, such as Computer Science, Engineering, and Physics (Hammond et al., 2020). Gender gaps persist in STEM jobs as well. For example, across twenty leading economies, women in Engineering comprise only 15 percent of workers (Hammond et al., 2020).

Similar to other parts of the world, gender differences in STEM education and careers are present in the Western Balkans region as well (Risteska, Memeti & Samardzic Jankova, 2020). Gender gaps in STEM are prevalent across disciplines and countries in that region. Women participation in Engineering and Technology fields in these countries is lower than that of men (Risteska, Memeti & Samardzic Jankova, 2020). However, the number of women enrolled or graduating from science-related majors, such as Mathematics, is higher than that of men across all the countries in the region (Risteska, Memeti & Samardzic Jankova, 2020). Gender inequality in STEM education transcends into STEM jobs as women are less likely to develop their careers in the technology field, whereas those women who graduate from science programs will typically develop teaching careers in the education sector (Risteska, Memeti & Samardzic Jankova, 2020).

There is a growing body of literature on the factors which lead to gender disparities in STEM education and professions, highlighting the role played by gender stereotypes and their effect on selecting certain education areas (Chatzi & Murphy, 2022). According to Cheryan et al. (2015), there are two types of stereotypes that influence women's participation in the fields of Computer Science and Engineering. One set of student stereotypes is about the culture (the type of work, the type of people working in certain professions, and the values attached to these fields), and the other set of stereotypes is about girls having less abilities in STEM fields, known as negative stereotypes about girls' abilities (Cheryan et al., 2015).

Reviewing the literature on the influence of gender stereotypes in women's participation in STEM education and careers is important for two reasons. First, while women in the Western Balkans are outnumbering men in math and science education enrollment, they are still underrepresented in Engineering and Technology fields. Followingly, women in the Western Balkans are employed more in lower-paid jobs as science teachers and are less employed in high-profile jobs as engineers or ICT specialists. Second, the disruptions created by the COVID-19 pandemic can also be seen as an opportunity for reshaping existing social norms and having more women involved in the digital society (International Telecommunications Union & Un Women, 2021).

The impact of gender stereotypes in steering women away from STEM fields is evidenced by a large body of literature across the world, however, this area of research is still understudied in the Western Balkan region. Therefore, this paper presents a scoping review of the literature on gender representation in STEM education in Western Balkan countries. In so doing, the paper first ascertains the prevalence of gender-STEM stereotypes among high school and university students in the Western Balkan countries and then it examines the extent to which educational choices of youth are driven by gender stereotypical beliefs and attitudes. The focus on high school and university students is because these age groups are either in the process of deciding or have already decided about their future careers.<sup>1</sup>

This review paper focuses on two research questions:

RQ1: What are the prevailing gender stereotypes in STEM among Western Balkan students?

RQ2: What is the effect of gender stereotypes in STEM on students' educational choices in the Western Balkans?

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<sup>1</sup> Since we are focusing on two age groups, namely high school and university students, when presenting gender differences among the surveyed students we refer to them as boys and girls and women and men, accordingly.

The rest of the paper is organized by presenting the review method, which is based on scoping review principles. Next, the results of the review are presented and organized according to the research questions. Then, we discuss our results along with other supporting studies. Finally, we conclude the paper with some outlook on directions for future work.

## 2. Method

As a guide to this review, we followed the framework proposed by Arksey and O'Malley (2005), which contained five main stages, namely: (S1) Identifying research questions; (S2) Identifying relevant research; (S3) Study selection; (S4) Charting the data; and (S5) Collating, summarizing, and reporting the results. Moving through stages was not linear, but rather iterative, which organically resulted in the adjustment of research questions and the eligibility criteria. The research team was multidisciplinary with backgrounds in Informatics, Economics, Computer Science, Psychology, and Physics. This joint knowledge contributed to analyzing the subject area from various perspectives (Levac et al., 2010; Peters et al., 2015).

### 2.1 The Scope

Research questions were raised during multiple discussions among authors, which identified the need for the necessary knowledge in relation to gender stereotypes and educational choices in STEM in the Western Balkan region. Thus, this introduced the geographical delimitation of the study to only focus on Western Balkans. Additionally, the included studies in the review focused only on high-school and university college students as we motivated this in the introduction section. Other delimitations, such as study period, type of study, specific STEM subject, the language of the article, etc., were not applied in this scoping review considering that we anticipated that the number of studies on this topic might be quite limited for this region and other delimitations could have a negative impact on the comprehensiveness of the results.

### 2.2 Paper extraction

We conducted three searches on Google Scholar, which was chosen because of its comprehensiveness in terms of indexing papers. To obtain accurate results, each query string was characterized with Boolean AND/OR operators and double quotes for combined words (e.g., "Western Balkan"). In Table 1 we report the details of these three rounds of searches, such as the query used, the period when we conducted the search, the number of papers resulting from the search, and the number of papers found relevant and included in the review.

**Table 1.** Details of three searches conducted in Google Scholar.

Search	Search Query	Period	Hits / Results	Papers Included
#1	"Western Balkan" AND (women OR girls) AND (stem OR mathematics OR math OR chemistry OR informatics OR physics OR biology OR "computer science")	March – April, 2021	1740	6
#2	Serbia OR Macedonia OR Montenegro OR Kosovo OR "Bosnia and Herzegovina" AND women AND (stem OR science) AND "gender stereotypes"	May – June, 2021	4200	4
#3	Used queries #1 and #2, but filtering only papers published in 2021 and 2022	March 2022	192	0
<b>Total number of articles included in the review</b>				<b>10</b>

The process of assessing papers for inclusion went through five phases: identification, screening, eligibility, exclusion, and inclusion (depicted in Figure 1). During the identification phase, more than a thousand papers were identified based on their title. Then, in the screening phase, these identified papers were assessed based on their abstract content, which resulted in 32 papers. In the eligibility phase, those 32 papers were assessed on the content of their full text, which resulted in nineteen potential papers to be included in this review. Finally, the number of papers included was ten as three papers were excluded due to not being STEM-related but discussed gender in general; five papers did not fit our target age group, namely pre-school (2 papers), primary school (1 paper), and post-college (2 papers). Two papers were based on secondary data, of which one paper was included because it discussed high school participants, whereas the other one was excluded as it only discussed career aspirations with professional participants.

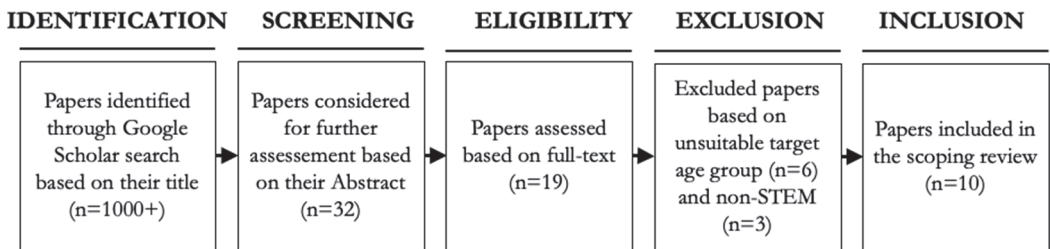


Figure 1. Paper inclusion process from identification to inclusion.

To summarize, through the screening and eligibility assessment, the following criteria were used: (1) peer-reviewed publications in journals, conference proceedings, and book chapters; (2) research discussing gender inequality in STEM; (3) it considered the high school and/or college generation; (4) based on primary or secondary data; and (5) it indicated to be an answer to our RQs. A minor exception to these rules was the inclusion of a relevant thesis work to RQ2. This paper is indicated with the number 4t in Table 2.

The pool of included papers was divided among all authors for in-depth reading. All authors had access and could provide comments and feedback about the articles via a shared collaborative document sheet. Finally, all authors were included in the discussion of articles and confirmed their approval for a final inclusion of each paper.

### 3. Results

As indicated in the methods section, this scoping review includes ten papers that are relevant to the research questions and the selection criteria. Table 2 provides an overview of the characteristics of included papers, in which we list the authors, relevance to the research question/s, study characteristics (primary or secondary data used in the article; sample size; and type of study), a subject covered, the geographic location where the study was conducted, and types of stereotypes identified in the study. Additionally, for easy identification, in the first column, each paper beside the order number is also labelled with a letter, depending on whether it is a journal (indicated with “j”), conference paper (“c”), or thesis (“t”). All papers were in English, except papers 1j and 8j, which were written in Croatian and Serbian language, respectively.

Table 2. Overview of papers included in the review.

#	Author (Year)	Research Question	Study characteristics	Subject	Location	Stereotype identified
1j	Arambašić (2005)	RQ <sub>1</sub>	Survey with 531 high school students (169 boys; 362 girls) Quantitative study (Inferential Analysis)	Math	Croatia	Perception of Math being a male domain subject
2j	Ivanović et al (2011)	RQ <sub>1</sub> & 2	Survey with 300 college students (200 men; 100 women) Quantitative study (Inferential Analysis)	Computer Science	Serbia	Women have low potential and capabilities in Computer Science
3c	Ivanović et al (2013)	RQ <sub>1</sub>	Survey with 355 college students (224 men; 131 women) Quantitative study (Inferential Analysis)	Computer Science	Albania, Bosnia and Herzegovina, Serbia, North Macedonia	Men are better than women in Computer Science Women unfit to lecture technical subjects
4t	Kacaniku (2015)	RQ <sub>2</sub>	Survey with 60 high-school students (30 boys; 30 girls) and 60 university students (30 men, 30 women) Quantitative study (Descriptive Analysis)	STEM (and non-STEM)	Kosovo	Parents' influence in girls choosing careers in teaching and nursing
5j	Perazić et al (2016)	RQ <sub>2</sub>	Study based on secondary data from state statistical office Quantitative study (Descriptive Analysis)	Civil Engineering	Montenegro	Women less confident in studying technical fields
6j	Jugović (2017)	RQ <sub>1</sub> & 2	Survey with 736 high-school students (439 boys; 297 girls) Quantitative study (Regression Analysis)	Physics	Croatia	Physics perceived as male domain Girls expected to study non-tech subjects
7j	Putnik et al (2017)	RQ <sub>1</sub>	Survey with 355 college students (224 men; 131 women) Quantitative study (Inferential Analysis)	Computer Science	Albania, Bosnia and Herzegovina, Serbia, North Macedonia	Men are better than women in Computer Science Women unfit to lecture technical subjects
8j	Lendák-Kabók & Popov (2019)	RQ <sub>2</sub>	Survey with 2192 high school students (1073 boys; 1119 girls) Quantitative study (Inferential Analysis)	STEM vs. Social Sciences and Humanities	Serbia	Men tend to study and pick careers in STEM fields, whereas women in teaching
9c	Ranković et al (2019)	RQ <sub>2</sub>	Survey with 104 women in college Quantitative study (Inferential Analysis)	Informatics	Albania, Bulgaria, Serbia	Women having career aspirations in the ICT fields (the only study without a stereotype identified)
10j	Dogan & Spahiu (2021)	RQ <sub>1</sub>	Analysis on 810 high school students participating in Project Olympiads (507 boys; 303 girls) Quantitative study (Descriptive Analysis)	Environment, Engineering, Have an Idea, Web Design	Bosnia and Herzegovina	Engineering and Web Design perceived as men dominated subjects

### 3.1 Prevailing gender stereotypes in STEM

Out of ten papers selected for this review, six were identified as relevant to RQ<sub>1</sub>, which investigates the existing gender stereotypes in STEM. The first four papers presented below show the strong presence of gender stereotypes in both high school and college students. These stereotypes are endorsed more by boys but are also evident in the education system and society in general.

In a survey conducted with high-school students, Jugovic (2017) finds that girls have better grades than boys in Physics subject; however, when compared to boys, girls report lower expectations of being successful in this subject. Additionally, boys were reported as being fitter to study Physics, which is perceived as a male domain, whereas girls were expected to study non-technical subjects as they were perceived as having poor talent in technical sciences. Specifically, only 23% of respondents

claimed that girls are more talented than boys in technical subjects. This is an indication of how norms and values are embedded in high school students' responses. The stereotype was stronger in boys who believed that are more talented in technical subjects, such as natural sciences and technology. The study also reports on the existence of gender stereotypes in other subjects and referring to the Croatian statistics, only 19% of graduates in the field of Engineering were women, 20% in Computing, and 41% in Architecture (Jugovic, 2017). When it comes to respondents' subjective task values, boys perceived Physics to be more useful for them than girls did, which was a sufficient requirement for them to choose a technical course as a preferred subject in university studies, whereas for girls, besides usefulness, they also had to reject present stereotypes in relation to gender and technical subjects. The study highlighted that girls felt discouraged to pursue studies in technical subjects due to perceived gender discrimination in workplaces.

Similar to this study that reports on stereotypes in the Physics subject with high-school students, there are two studies with college students that report stereotypes on the subject of Computer Science (Putnik et al., 2017; Ivanovic et al., 2013). Both studies report insights from the same collected data, a survey with 355 college students, of which 131 were women. The inferential analysis revealed that girls compared to boys, score higher and have better grades on math courses. In North Macedonia, Bosnia and Herzegovina, and Albania, women are more concerned than men about their future career, whereas in Serbia both genders were equally positive. Gender stereotypical beliefs are revealed by the question of when women and men are asked whether there is a lack of women in the field of Computer Science, which was positively answered by two third of women as compared to less than half of the men. Similarly, on the question of whether Computer Science is an adequate field for women, more women (95%) than men (81%) answered affirmatively. The greatest stereotype endorsement, however, is indicated by the question of whether women are better than men in Computer Science. In this question, 51% of women answered affirmatively versus only 8% of men. Furthermore, men reported lower ratings for female teachers in their courses, perhaps indicating the perception that women are not a good fit to lecture technical subjects. Also, men rated with only 12% positive the level of computer skills of their female student colleagues. Indicatively, men tend to not agree that in Computer Science, women are more careful and more skillful than men.

Gender stereotypical attitudes about the role of women in Computer Science were also found in an earlier study conducted in 2011 (Ivanovic et al., 2011), with Serbian students. The authors found that when compared to women, men expressed reservations about the potential and capabilities of women in Computer Science. The results of this study were derived from a survey conducted with 108 students, of which 42 were women and 66 were men, representing four years of studies at the Department of Mathematics and Informatics. The study focused on examining students' performance, professional motivation, and ambition as well as their attitudes toward gender differences.

The last two papers related to RQ<sub>1</sub> show somewhat lower but still existent stereotypes among high school students. Arambasic et al. (2005) conducted a quantitative analysis by surveying 510 high school students, of which 362 were girls. They investigated the participants' attitudes towards the subject of Mathematics in two study programs, namely, Language and Math/Natural Sciences. The study revealed that, in general, participants did not support the belief that Math is a subject dominated by men, although, in the Language program, the number of boys that thought of Math as a men domain was higher than that of girls. Authors do insinuate the existence of stereotypical belief that Math is a men domain, although this was not strongly supported by the data. In terms of being anxious when taking a Math course, girls showed higher levels of anxiety compared to boys, although authors speculate that anxiety levels might be the same among both genders; however, girls are more prone to report it.

A study by Dogan and Spahiu (2021) investigated the effect of extracurricular practical activities on students and teachers. The study focuses on the Science Olympiad in Bosnia, which includes competition in four subject categories: Environment, Engineering, Have an Idea, and Web Design.

The results of the study show that participation in science projects has a positive impact on science-related education. As for the relationship between gender and the subject of competition, results show that men mainly participated in the competition in Web Design and Engineering, whereas women participated in Environment (44%) and Have an idea (40%) related categories. Such preferences are most likely due to existing stereotypes with Engineering and Web Design being perceived as more men dominated subjects. The authors further claim that participation in out-of-class science activities such as the Science Olympiad has a positive impact on paving the path towards science related education. These events provide a platform for socialization, learning, and increase the students' self-confidence and interest to pursue science-related studies. In addition, participation in science projects contribute to inter-ethnic communication, especially in post conflict countries, as is the case with Western Balkan region.

### 3.2 Gender stereotypes and educational choices in STEM

Out of ten papers selected for this scoping review, seven papers were relevant to RQ2. Note that two studies that reported on the existence of gender stereotypes in STEM (RQ1) also report on the effect of gender stereotypes on educational choices in STEM (RQ2). For instance, Jugovic (2017) highlights that boys aspire for more career domains perceived as suitable for men, such as Physics. On the other hand, although girls had better grades than boys in natural science subjects, because of gender discrimination in workplaces, they were discouraged to study technical sciences. Similar to these observations in Croatia, girls in Montenegro are also affected by stereotypes inherited by the communist era which shows that girls mostly aspire to study art and social studies and are less prone to pursue education and careers in technical sciences, which are dominated by boys (Perazic et al., 2016). The study highlights that women are still seen as unfit to own properties and run businesses and the only way to mitigate these limitations is early on in education on challenging the traditional stereotypes. Despite the improvement trend in Civil Engineering where the number of girls has been increasing in studying this subject, still in comparison to boys, girls are fewer in numbers. An interesting fact is that based on their quantitative analysis of secondary data obtained from the state statistical office of Montenegro, up until university master studies, the enrollment numbers for girls either exceed or are similar to boys (Perazic et al., 2016).

Similar findings are reported in a study by Lendák – Kabók and Popov (2019) which examined gender differences in the choice of studies of ethnic minorities in the province of Vojvodina, Serbia. The educational system of Serbia gives an opportunity to the members of Hungarian, Slovak and Romanian ethnic groups to complete primary and secondary education in their mother tongue, however, most of the university programs are offered in the Serbian language. The minority groups decide whether to continue their studies in the higher education system in the Serbian language, which language is predominantly used in teaching activities, or leave Serbia and continue studies in their mother tongue in Hungary, Slovakia, and Romania. The authors tested the hypothesis on gender differences and impact on migration and choices of the study between pedagogical professions on the one hand, or studies in STEM, on the other hand. The analysis was based on a large sample of high school students from 16 municipalities in Vojvodina. Both men and women from the 2013/2014 and 2014/2015 school years, participated in the survey. The results show that around one third of high school students migrate and continue their studies abroad. When it comes to gender differences, boys are more likely to leave Serbia and choose to study a STEM field, whereas women tend to choose the teaching profession. The paper suggests that the higher education system in Serbia should introduce gender quotas or positive discrimination in STEM areas and empower women in STEM fields.

Gender-specific career aspirations were also found in the thesis study conducted by Kačaniku (2015) which reports on the factors that determine the education pathway of students in the capital of Kosovo. The study was based on a survey conducted with 120 respondents, representing both genders, and high-school and college students, proportionally. Results of the study reveal four

determining factors driving the choice for undergraduate study fields: influence from parents, financial constraints, low high school involvement, and stereotypical beliefs. These factors result in a lower tendency of women to choose STEM related education most likely correlated with the fact that parents' influence and control were more prominent among women than men. Both genders expressed a low level of participation in STEM related activities in high school. However, results revealed that women are more underrepresented in these activities compared to men and this is because schools design these activities to be more oriented towards men, hence discouraging women. Thus, men perform more core STEM activities and more often than women, which prepare them better for STEM disciplines. Both genders expressed their beliefs that there are gendered professions. The most gendered careers were Teaching and Nursing for women, and Engineering and Mathematics for men. The study recommends establishing a program in high schools to assist women in their decision making, use women role models, and revise and update the curriculum at the Ministry level.

Ivanovic et al. (2011) find that there are no gender differences in students' academic performance; however, there are gender differences among factors that influence students' educational choices. Men highlighted their interest in computers and the opportunity to work abroad as important factors in driving their decision. Women on the other hand mentioned financial security and voiced concerns of unemployment. When compared to men, women were more ambitious to pursue academic careers after their studies. In terms of the attitudes related to gender, results show that both men and women were affirmative that Computer Science is a good field for women and undoubtedly good for men. Nevertheless, women compared to men acknowledged that there is underrepresentation of women in the field.

A study that is different from studies thus far is the study by Rankovic et al. (2019) which reports on women having career aspirations in the ICT field. The analysis of this study was based on a survey with 104 college women in three Western Balkans countries: Albania, Bulgaria, and Serbia. In this quantitative study involving referential statistics, authors examined student satisfaction, experiences, and prospects for studying the Informatics/Computer Science subject. The findings reveal that when deciding their future study subject, women are mainly driven by their interest in computers despite their parents' suggestion to study non-technical subjects. Women are also motivated by world-famous scientists in the ICT field, regardless of whether their parents worked in such a field, which did not seem to inspire girls to pursue an ICT degree. Surveyed girls showed high confidence in their abilities and stated that women are more meticulous compared to men. An interesting finding is that participants believe that for a career in ICT, women are prepared to sacrifice family time, although they have a strong belief that such sacrifices are not necessary because family and professional life could co-exist.

#### 4. Discussion

This scoping review paper aimed to review the literature on gender stereotypes in STEM education and the extent to which career choices and aspirations are influenced by gender stereotypical beliefs among youth in Western Balkan. Out of ten studies included in this review, two studies addressed both research questions (RQ<sub>1</sub> and RQ<sub>2</sub>) whereas RQ<sub>1</sub> and RQ<sub>2</sub> were accordingly addressed by six and seven studies in total. Except for one paper, the reviewed studies used primary data, collected from high school and college students. Studies included in this review are based on descriptive or inferential analysis whereas, in one study, the author analyzed students' gender related choices through the lenses of the expectancy value model using hierarchical regression analysis.

The review results confirm gender stereotypical perceptions about STEM subjects among high school and college students in the Western Balkans. Most students participating in the studies included in this review, perceive technical fields of study, such as Physics and Informatics, as subjects that are a better fit for men as compared to women who are expected to be more talented and better equipped to study and excel in non-technical subjects. These attitudes extend outside regular classes



to extracurricular science activities such as student competitions through which boys were reported to have been overrepresented in Engineering and Web Design categories as opposed to girls who participated more in other categories such as Environment and I have an idea.

Important to be highlighted is the comparison between boys' and girls' perceptions about their own and out-group capabilities in studying in technical fields. Stereotypical beliefs about students' capabilities in studying in STEM fields are endorsed more by boys: they believe that members of their gender group are more talented and capable in natural sciences and technology courses. These results are in line with much of the existing evidence from other parts of the world whereby men typically favor their gender in-group as being better in science and mathematics and thereby confirming traditional science and math gender stereotypes (Passolunghi, 2014). Similarly, gender differences in the rating of women's abilities in STEM extend to their older female peers and female teachers, whereby men rated lower their female teachers as compared to their male counterparts. This shows that gender stereotypes among youngsters are evident throughout the entire STEM path and not confined to their peers only.

Negative stereotypes about girls and women's abilities in Science and Mathematics seem to make girls experience more stress and anxiety when they take STEM related subjects. Specifically, one of the reviewed papers shows that girls report more anxiety in Math classes as compared to boys. This finding confirms previous studies from countries outside Western Balkans which reported more Math anxiety among girls, and in turn, a negative relationship between Math anxiety and Math performance among girls (Van Mier, Schleepen & Van Der Ber, 2019). As women expect to perform poorly in advanced Math tests, they tend to avoid fields of study that involve a lot of Math (Marx & Roman, 2002). The negative stereotype about women's abilities in science majors is thus seen as an important predictor of women's choice of profession (i.e., their major field of study).

In the second part of the review, we, therefore, explored the question of whether educational choices among students are gender specific. Findings from the reviewed studies suggest that gender-nuanced educational choices are indeed present among youth in the Western Balkan countries. The findings from six papers confirm that boys typically tend to choose education programs and professions which fall in the STEM fields of study, such as Computer Sciences, whereas women choose professions outside of STEM fields and within social sciences, such as Teaching and Nursing.

It is worth noting that even when women have already chosen to study in STEM majors, such as Computer Science, their male peers continue to see them as less fit for this field of study. However, this does not seem to be the case when women are rating their male counterparts; on the contrary, both genders equally agree that Computer Science is a good field for men.

Another interesting result from two of the reviewed papers (Lendák – Kabók & Popov, 2019; Ivanovic et al., 2011) is the gender differences regarding students' career choices and their plans to move abroad. In the case of student minorities in Vojvodina, more high school boys than girls preferred to study abroad in order to secure an EU diploma, whereas more girls than boys preferred to study abroad due to the possibility to work in their mother language and to choose among different study profiles (Lendak-Kabok & Popov, 2019). When looking at the influential factors for choosing to study Computer Science, Ivanovic et al. (2011) found that the possibility to work abroad was significantly higher for men. Women, on the other hand, chose to study Computer Science as they are significantly more concerned than men about the risk of being unemployed.

Taken together, the attitudes and career aspirations of students from the reviewed results reflect the actual distribution of jobs occupied by women and men in the Western Balkans. Labor market figures of the Western Balkan countries reveal the presence of occupational segregation where women are employed mostly in professions that considered traditional women occupations (Kolin, 2010; Beqiri & Selimi, 2015). In other words, women work in professions that are typically seen as *people* oriented as compared to men who work in professions that are typically seen as *things* oriented (Su, Rounds & Armstrong, 2009). The endorsement of such stereotypes by youth is influenced and shaped by the existing social norms and values (Demukaj, Maluku & Beqa, 2018).

Findings about gendered educational choices and occupations have important policy

implications for the debate on gender inequality, in general, and the gender pay gap, in particular. First, empirical evidence on the gender pay gap increasingly suggests that this gap is driven in part by the allocation of professions between women and men with women working in lower paid professions (Chamberlain, 2016; Banerjee, 2014). In the Western Balkans context, although girls and women are increasingly performing better in the education system, they are still underrepresented in the high paying jobs, exhibiting weaker labor market outcomes. It has been estimated that on average, about 18% of GDP is lost due to gender gaps in the labor market, with one-third of this gap being attributed to the occupations chosen by women (World Bank, 2018). In the same vein, ITU and UN Women (2021) argue about a 'leak in the pipeline' between STEM graduated women and technology employment in the Western Balkan.

Second, as the fastest growing professions of the future will fall within the STEM domain, it is of utmost importance to address occupational segregation by gender and expand opportunities for women to work in these high-profile professions (World Economic Forum, 2020). Like worldwide trends, the closing of the gender gaps in digitalization and STEM in the Western Balkans is listed among the key drivers for the economic empowerment of women (UNDP & RCC, 2020). Part of the reason is arguments in a study by Georgiadou et al. (2015) claiming that prevailing gender stereotypes hinder women from participating in technology and career development toward managerial positions. As a result of the evolution of digital technologies, these stereotypes have now also permeated the work practices or professions which have traditionally been dominated by women. Such an example is the librarianship profession, which nowadays because of the pervasiveness of digital technologies is introducing new roles and demands, mainly technical, with men typically occupying technological leadership positions. As a result, technological development becomes an obstacle for women to reach promotions or managerial leadership positions, even in traditionally female dominated professions. This is due to prevailing assumptions (stereotypes) that technical positions are associated with men. ITU and UN Women (2021) therefore highlighted that the inclusion of women in the digital society is critical amidst post-covid recovery efforts. This presents an opportunity for women to capitalize on these current global technology trends and for tapping into emerging professions which will ultimately improve their labor market outcomes. Improved labor market outcomes for women are pivotal for gender equality and for achieving inclusive growth.

#### 4.1 Method discussion

We finalize this discussion with reflections on the method used. This paper has contributed synthesized insights from previous studies on the existing gender stereotypes and career aspirations in STEM in the Western Balkan region. However, the paper exhibits some method limitations. Primarily, the review builds upon a rather small number of studies, which could potentially affect the reliability of the results and the possibility of drawing general conclusions. In addition, some of the included papers are not the most recent, hence there is a possibility that the situation has changed, especially due to the COVID-19 pandemic transforming the nature of education and work. And finally, the included studies were not evaluated for their quality in terms of methodology or data, as it was not the objective of this scoping review.

## 5. Conclusions and Future Work

This scoping review paper contributes to providing an overview of studies related to gender and STEM in the region of Western Balkan. The included papers give a clear indication of prevalent gender stereotypes in STEM in that region. Moreover, these stereotypes are propagated influencing women's educational choices and career aspirations in STEM.

An evident finding of this review is the limited number of studies that exist in this topic for that region. The low number of papers included in this review is a clear indication of the existing knowledge gap, despite our strategy to adopt a generous inclusion criterion. This sets an agenda for

future work that needs to be done in order to better understand the interplay between gender and STEM education and career. As this review only included high-school and university students, future research should also focus on earlier age groups, as the existing evidence suggests that gender stereotypes set in as early as preschool years. Additionally, we also need more studies to investigate women graduates in STEM who do not pursue their careers in STEM jobs and are therefore lost in the pipeline. These future endeavors call for the utilization of systemic approaches. The intersection between gender and STEM and the effect of stereotypes and gendered career aspirations is a systemic phenomenon, which needs to be understood as a part of a larger context. Utilization of Systems Thinking (Midgley, 2007) as an overarching perspective will allow a holistic examination, by including relevant actors within and outside the immediate context, such as parents, schools, policymakers, businesses, and organizations. As the review revealed, all these actors have an impact and shape stereotypes and future career decisions.

Finally, given that most available research has a quantitative character, a complementary qualitative approach to studies in this topic is needed. Such studies will contribute to gain in-depth understanding and capture experiences, patterns, and the context of this phenomena.

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