

PERSPECTIVES OF STEM EDUCATION REGARDING SERBIAN SECONDARY SCHOOL STUDENTS' MOTIVATION FOR CAREER CHOICE

Jelena Ž. Maksimović,
Jelena S. Osmanović,
Anastasija S. Mamutović

Introduction

The selection of one's profession is one of the most important, yet most difficult decisions in one's life. This selection is additionally burdened by a great number of options offered to adolescents. On the other hand, this decision is made during the period of identity development when the majority of adolescents are still not aware of their own preferences and interests (Van der Gaag & Van den Berg, 2017). Therefore, the selection of academic studies and future profession represents one of the crucial issues that troubles adolescents upon graduating from secondary school (Alberts et al., 2003).

The decision about the choice of profession should be based on two key factors: the prospects of the selected profession and the employment options (Kniveton, 2004). All the more owing to the fact that fast advances in science and technology represent the main reason why certain professions are facing extinction whereas some new ones are thriving. Therefore, it is important that students realise which jobs are in great demand in the labour market. Otherwise, a further discrepancy between the matriculation policy and labour demand policies will result in an unnecessary surplus of occupations and, consequently, an increase in unemployment among college graduates.

The results of the research conducted by Creed and Patton (2003) identified gender differences regarding the choice of career. Actually, the research determined that young female respondents displayed a higher level of career maturity and concern for their own career and employment in comparison to their male counterparts. As regards gender differences, it is worth mentioning that various research results proved that unlike male adolescents, female school-age adolescents rarely chose professions in sciences (Miller et al., 2002; Wilgosh, 2002).

Research results also showed that students' decision regarding their career choice was influenced by their parents, teachers and school counselors. Namely, the results obtained from the research conducted by Taylor et al. confirmed that 72.2% of parents assumed that the career choice should



JOURNAL
OF BALTIC
SCIENCE
EDUCATION

ISSN 1648-3898 /Print/
ISSN 2538-7138 /Online/

Abstract. *The research was motivated by the necessity to examine the perspectives of STEM professions in Serbia. The aim of this research was to study students' motives for career choices and their attitudes towards STEM sciences. The empirical scientific approach was applied, i.e. the quantitative and qualitative research method. The most frequently chosen undergraduate majors, the motives that determined that choice and the professional interests were examined by the interviewing technique in the first phase and the scaling and survey techniques in the second phase of the research. The participation in the research was voluntary and comprised of Serbian secondary school students. The research ascertained that a poor state of the national economy determined the students' decision to be trained for "jobs of the future" rather than attend the desired studies. The professions in the IT sector, engineering and sciences proved to be the most profitable ones. These results proved a growing popularity of STEM professions among the Serbian students, but they also implied the prospective necessity to promote mathematics and engineering within the education system considering the present insufficient interest in these academic studies. Regarding the fact that this type of scientific research is still rarely conducted by Serbian experts in the relevant field, this research contributes to a more comprehensive review of the STEM education.*

Keywords: *academic studies, professional interests, STEM, secondary school students*

Jelena Ž. Maksimović,
Jelena S. Osmanović,
Anastasija S. Mamutović
University of Niš, Serbia



be based on the combination of a schoolchild's interests and skills and the labour market demands. However, considering the issue of the most important factors for the career choice, 27.6% of the respondents believed that it was the skills, whereas 0.2% of them thought that it was the labour market (Taylor et al., 2004).

Regarding the demands of the contemporary labour market, it is essential to mention the STEM field that involves some of the most significant and most wanted professions responsible for the majority of innovations. An unprecedented technological development has contributed to the fact that the economic power depends on the number of qualified employees working in this field. Therefore, the national success and leading position are not conditioned only by an adequate use of technology but also by a potentially increasing number of employees in the national STEM field. Consequently, technological economy and highly qualified human resources in the STEM field represent the moving force behind any social progress (Hossain & Robinson, 2012). Today, there is also a need for individuals with adequate skills in technology as well as the need for mathematically literate individuals in the twenty-first century business world. The need for technology literate individuals who understand technology, use it correctly and closely follow technological developments has also increased (Yıldırım & Sidekli, 2018). The diversification of the science, technology, engineering and mathematics (STEM) field requires new skills, including an ability to work with diverse groups of people (Fuselier & Jackson, 2010).

Students are faced with their choice of academic studies and further university education, which in turn defines their future profession. Therefore, they should be properly and adequately informed about STEM education. Moreover, motivating young people to work in the STEM field has become an essential task of humanity, on both national and global level. The number of students who develop their careers in the STEM field can be increased by eliminating prejudices and increasing students' awareness of the true nature of STEM careers. The students who are properly informed during their secondary education are able to make judicious choices regarding their university education and to be better prepared for their STEM professions (Wyss et al., 2012). Therefore, positive experiences gained during secondary education are crucial for the development of students' interest in STEM professions (Ertl et al., 2017; Fouad et al., 2010; Luttenberger et al., 2019).

The term STEM¹ is commonly used as the acronym for four individual fields – science, technology, engineering and mathematics. The previous decade witnessed international debates on STEM education. The reason lies in the fact that fluctuating global economy and labour market demands predict a potential deficit of STEM competent professionals on the global level. Hence, both developed and developing countries emphasise that the improvement of STEM education represents the key factor for stimulating economy. In other words, the main goal of STEM education is an adequate training of students (perspective workforce of the twenty-first century) for the labour market of the twenty-first century (Kennedy & Odell, 2014).

The present deficit of employees qualified for working in the STEM field has induced the creators of global education policies to focus their attention on improving competences in the STEM domain. Although the idea of STEM education first appeared in the USA during the nineties of the twentieth century, the shortage of teachers able to assist in accomplishing the goals of STEM education is evident, and so is the number of experts in STEM professions. The majority of countries state that training of future employees to improve national economies and maintaining leadership in the situation of constant changes and expansion of globalised economy represent their primary goal for attaining better results in STEM education (Kelley & Knowles, 2016).

Efforts aimed at increasing students' interest in professions related to science, technology, engineering and mathematics (STEM) are growing internationally. Such tendencies are directed towards securing an economic growth and social progress by STEM professionals. It is thus necessary to encourage and motivate students, in particular, to start their careers in the STEM field, because this period of life is characterised by young people's strong desire to learn about their own interests, abilities and academic inclinations (English, 2016; Kier et al., 2014). The identification of the students with academic and career potentials for science, technology, engineering and mathematics can be accomplished by creating reliable instruments that measure the level of their knowledge about and interest in STEM professions (Tyler Wood et al., 2010).

However, careers pertaining to the STEM field are frequently exposed to prejudices and gender stereotypes. Actually, the IT career is commonly considered to be more appropriate for males (Stout et al., 2011). The reasons are numerous, some of them conditioned by the overall picture presented in the media. One of the problems is

1 It is important to differentiate the term STEM from another term, STEAM, which includes art besides the already mentioned science, technology, engineering and mathematics, but also from yet another term, used at some universities, STEMM, which involves the study of medicine, as well.



also the fact that examples of successful female experts in the IT sector are lacking. The results of the research conducted by Thomas and Allen (2006) showed that students' interest in IT professions diminished over time, while the reasons for this differed among male and female respondents. Unlike girls who do not want to be labelled as nerds, boys state boredom and lack of creativity at work as their main reasons. Both groups claim that the sources of their decision to abandon the IT profession are closely related to media, school and friends.

The research results proved that the interest of students in STEM professions was determined by gender. Unlike female respondents predominantly interested in the field of biology, male students were mainly interested in physics (Baram - Tsabari et al., 2009).

Also, the results of the research confirmed that even engineering, as part of the STEM field, was prone to stereotypes. Namely, the prejudices about STEM professionals start at an early age and are related to the belief that the job of an engineer is exclusively reserved for males (Capobianco et al., 2011).

Contrary to the aforementioned, the results of the research conducted by Kitts (2009) demonstrated that some progress had been made in reducing prejudices against STEM professionals. According to this research, school-age children considered sciences interesting and they thought that their choice of a STEM profession would make their parents proud. Moreover, the results of this research showed that scientists were no longer regarded as male atheists.

The fact that Serbia has failed to keep up with other countries in the number of STEM professionals, as well as the fact that the research studies of students' academic and professional choices are sparse determined the aim of this research: to examine whether students' enrolment in academic studies was based on their own preferences, abilities and interests, or on the labour market demands and social acceptance of certain professions as prosperous. More precisely, the aim was to indicate both students' contemporary tendencies related to their choice of university education and consequently future professions, and students' perceptions of and attitudes to STEM education.

The general hypothesis was thus postulated which implied that there existed a trend among Serbian students to frequently choose STEM professions. Specific hypotheses were postulated in the following way: It is assumed that students' selection of the desired academic studies and future professions is based on their reflection on their own ambitions, future employment options and material wealth to be provided by a prospective profession, and that students consider STEM professions to be the most thriving ones in the labour market; It is assumed that students predominantly select university education in sciences (mathematics, physics, biology, chemistry, geography), technology and engineering; It is assumed that students' selection of future academic studies is primarily conditioned by future employment options and prosperous professions they will be qualified for; It is assumed that Serbian students are interested in IT professions, as well as in social work and foreign languages jobs; It is assumed that Serbian students assess sciences and technology more positively than mathematics and engineering.

The conducted research studied the disparity between the labour market demands and the academic choices favoured among secondary school students. The basic limitation observed was the insufficient knowledge offered to Serbian students about the advantages of STEM education. This problem might be solved by incorporating more useful information about this education in course of both curricular and extracurricular school activities. Moreover, it is important that the Serbian education system recognises STEM education as a unified study field requiring the latest technology and equipment but also highly qualified teachers.

Despite the fact that the twenty-first century has already recognised the necessity of highly-qualified personnel in the STEM field as a priority in the competitive global economy, as a precondition of economic power, success and leading position of one nation, the education system in Serbia still lacks a sufficient number of experts graduating from science, technology, engineering and mathematics. In addition, the Serbian matriculation policy is not accorded with the labour market demands, which inevitably results in the surplus of unnecessary qualified employees and deficit of the necessary ones. Regarding the fact that the STEM field includes some of the most wanted and most thriving contemporary professions, the subject matter of the research was related to the issues of prospects, status and place of STEM professions in the education system of Serbia.

Thus, the following research questions were posed: Which professions do students select most frequently? Which academic studies and professions do students choose predominantly? What are the motives that govern the choice of profession? What are the students' attitudes towards STEM sciences?



Research Methodology

General Background

The disparity in growth in the graduate and STEM-related vacancies demonstrates a widening gap, indicating the increasing demand for STEM experts. In other words, the chances of employments are higher for STEM graduates. However, while the demand for workers specializing in STEM-related fields is continuously growing, the enrolment at the graduate level is consistently recording a decline, leading to gaps in employment (Mohtar et al., 2019). The research employed both qualitative and quantitative methods of data collection and analysis. This was done to ensure triangulation of the data.

Research Design

The study lasted 16 weeks. During the first phase of the research in January and February, thirty students were interviewed in order to determine which professions they considered prospective in the labour market, what obstacles they encountered when selecting a desired profession and whether certain external factors, such as family and friends, influenced their decisions about the choice of academic studies and future professions.

In March and April, the techniques of scaling and survey were performed with the respondents in order to examine their attitudes towards employment prospects depending on the degree in either sciences and technology or social sciences and humanities and the importance of personal abilities and interests or material wealth.

Sample Selection

The latest census of population conducted by the Statistical Office of the Republic of Serbia in 2019 revealed that there were 249 455 secondary school students in Serbia (<https://www.stat.gov.rs/en-US/oblasti/obrazovanje/srednje-obrazovanje>). The representative sample had the following demographic characteristics: gender ($f=342$ female students and $f=163$ male students), school grade (the first grade $f=131$, the second grade $f=122$, the third grade $f=131$, the fourth grade $f=121$) and academic achievement (insufficient $f=5$, sufficient $f=1$, good $f=49$, very good $f=181$, excellent $f=269$). The sample of the students to be interviewed was collected by conducting interviews with principals of 5 randomly selected secondary schools in Nis who gave permission for the research to be conducted and consented to the students being interviewed, which was done during the first phase of the research. Thirty students agreed to individual interviews. The ongoing COVID-19 pandemic disrupted the field research in schools. The research sample consisted of 505 respondents, which means that the reliability criterion of 95% was fulfilled.

Instrument and Procedures

The interview consisted of 9 open-ended questions, purposefully constructed for this research requirements: When did you first start thinking about which faculty to enrol in? How did you make a decision in which faculty to enrol (what had a crucial impact on your decision)? Have you ever changed your decision regarding your choice of the undergraduate major during secondary school (if yes, what were the reasons)? What is more important: the job that you like or the job that secures financial wealth? State the advice provided by family and friends regarding your decision about the choice of the undergraduate major. Regarding the experiences of the young people from your nearest surrounding, what field of study qualifies you for the quickest employment? State your opinion about the most prospering jobs in our country and abroad. What obstacles have you encountered when choosing a desired undergraduate major? What are the alternative jobs you would accept in case you do not find the job in your field of study? Each interview lasted for 25 minutes.

The second phase of the research involved the collection of email addresses of secondary schools on the territory of Serbia, which were obtained from the site srednjeskole.edukacija.rs, and the invitation to participate in the research. The secondary school authorities that responded to the invitation were informed about the nature of the research and delivered the electronic version of the instruments to be distributed to their students via emails, social networks and Google Classroom application, which was used by the majority of Serbian teachers during the Covid-19 lockdown. The following instruments were used:



- the questionnaire consisting of five closed-ended questions, the first three related to the demographic characteristics of the sample (gender, academic achievement, school grade) and the other two referring to the selected academic studies and desired professions.
- Likert-type scale to examine the respondents' motives for selecting particular academic studies (1 – completely disagree, 5 – completely agree). The Cronbach's alpha test for the scale of motives was 0.79, which indicated the reliability of the scale for the studied sample.
- The students' attitudes towards sciences pertaining to STEM education and towards STEM careers were examined by means of the assessment scale STEM Semantic Survey, designed Tandra Tyler-Wood, Gerald Knezek and Rhonda Christensen (Tyler-Wood et al., 2010). This instrument contains 25 items that examine the interests in science, technology, engineering, mathematics and STEM career. The instrument was modified and translated into Serbian for the purposes of this particular research. The students were offered five antonym adjective pairs, opposite in meaning. The numbers on the scale express the following meanings: 1 – fascinating, 2 – not so fascinating, 3 – fairly common, 4 – common; 1 – attractive, 2 – not so attractive, 3 – fairly unattractive, 4 – unattractive; 1 – exciting, 2 – not so exciting, 3 – fairly unexciting, 4 – unexciting; 1 – totally unimportant, 2 – unimportant, 3 – fairly important, 4 – very important; 1 – boring, 2 – not so boring, 3 – fairly boring, 4 – interesting. The Cronbach's alpha test for the assessment scale regarding STEM sciences was .77, which indicated the reliability of the scale for the studied sample.

Ethical Considerations

The respondents' participation in the research was voluntary. Prior to the research, the students were informed about the nature and goals of the research, their part in the research, confidentiality of their identity and personal information collected during the interview (during the first phase of the research), completing of the online instruments (during the second phase of the research) and the right to quit the research at any time. The ethical consideration regarding the confidentiality of personal data was acknowledged by disabling the option (adjustment) for collecting email addresses on Google Forms, which could disclose the identities of the respondents. Moreover, parents of those research participants who were still minors during the interview were required to sign an informed consent agreement for the participation of their children in the research.

Data Analysis

The qualitative data were analysed by the classification of the collected material. The data obtained from the interviews were processed in five steps (Griffiee, 2005). The first step involved listening to the recordings. The second step was reading the transcriptions several times. The third step was coding the interviews according to the topics distinguished from audio transcriptions. The fourth step was writing the summary of the coded data. The fifth step was the interpretation of the findings. The same procedure was repeated for all of the questions.

The quantitative data were analysed in the following manner: χ^2 test was used for the of the survey data, descriptive statistics was used for the assessment scale of the choice of the faculty and the scale of attitudes towards the STEM scientific disciplines, and the parametric *t* and *F* test was used for determining the statistically significant difference in students' attitudes regarding gender, grade and achievements at school. The quantitative data were processed in the programme for the statistical data processing SPSS. 25.

Research Results

As regards the point of time at which the respondents decided about their future academic studies, the presented responses prove that the majority of them reached the decision when starting secondary school which was influenced by their being aware of the importance of that choice. The second category of responses prove that a number of students reached this decision during secondary education while the third category of responses illustrates that some students did not even consider the idea about future academic studies because they thought they had enough time to decide.

Considering the crucial motivation for selecting particular academic studies, the first category involved the responses of the students with intrinsic motivation for the choice of the undergraduate major. The second category



included the responses of the students with extrinsic motivation for the choice of the undergraduate major while the third category included the responses of the students with dominant both intrinsic and extrinsic motives.

The issue related to the respondents' consistency in their choice of desired academic studies was approached differently. The first category involved the responses of the students who showed consistency in their choice of academic studies, whereas the second category displayed some changes in their choice of academic studies.

The fourth question examined whether the choice of academic studies depended on the respondents' personal preferences or on potential material wealth that the university qualification might bring. The first category involved the responses of the students that favoured their own interests when selecting their future profession. The second category included the responses of the students who favoured financial wealth that a potential future profession might secure while the third category comprised the responses that showed approval of both personal interests and financial security when choosing a future profession.

The question related to the degree of the family and friends influence when selecting academic studies was answered differently. The first category of responses comprised the responses of the students who had not been advised by family and friends about their choice of the undergraduate. The second category involved the responses which revealed that the decision about the choice of the undergraduate major had been imposed on the students by their family and friends while the third category included the responses of the students who had been advised by their family and friends about the importance of their individual decisions and their own ambitions when choosing their academic studies.

Regarding employment options, the first category of responses showed that the respondents considered technology and engineering to be the fields that provided easy employment, while the second category proved that degrees in medicine and natural sciences secured easy employment.

The first category of the responses to the question about the most prosperous jobs in Serbia and abroad included the responses of the students who considered the same jobs, i.e. those pertaining to technology and engineering, to be prosperous in both our country and abroad. The second category comprised the responses of the students who thought that different jobs were prosperous in our country in comparison to those abroad.

As regards the obstacles encountered when making decisions about their university education, the first category contained the responses of the students who emphasised the financial problems as obstacles. The second category of the responses emphasised the obstacles related to their personal indecisiveness and uncertainty about their own choices. The third category contained the responses of the students who emphasised the obstacles related to the admission criteria of certain university studies.

Finally, the responses to the question referring to alternative professions were divided into three categories: those who were decision-determined considering their field of study, those who would start their own business and those who would decide to work from home in case they failed to find the job in their field of study.

The responses presented in Table 1 prove that Serbian secondary school students have positive attitudes towards STEM education and relevant qualifications. However, their responses exhibit that they have other preferences considering their university education and select academic studies that do not belong to STEM education.

Table 1
The Most Representative Responses

Research questions regarding the choice of academic studies	Category 1	Category 2	Category 3
Point of decision-making	-In the eighth grade of primary school -When I decided which secondary school to attend -I think that all of us have thought about future profession since an early age, but the first time I myself began to think about this seriously was before I started secondary school	-In the third grade of secondary school - I knew what I wanted to do the moment I started secondary school -During the summer break between the third and fourth grade".	-I haven't decided yet -I do not think much about it -I haven't thought about it yet, I think I still have time



Research questions regarding the choice of academic studies	Category 1	Category 2	Category 3
Motivation	-My interests, something I have been interested in since my childhood and whatever is not boring for me to learn and acquire new knowledge -Whatever makes me confident and successful as an individual -I wanted something that would please me	-Employment is found rather easily, possibility to work abroad, good salary -Possibility to be employed in both state institutions and in the private sector -Good job, good monthly payment, easy employment	-I have considered my interests and selected my future profession that will provide a good salary -I have taken into consideration my preferences, interests, but also the financial gain -To have a job that I love and can live well off
Consistency in decision-making	-I have never changed my decision - No, never, because I am determined about my final choice of my university education and the job I would like to do after graduation -I have never changed my decision about my studies during secondary school	-Yes, I have, I have not been certain what I really want -Yes, twice. I am still considering the idea of my future studies -I have changed my decision since I have often changed my own perception, I am trying to find something that will best suit me	/
Personal preferences vs. financial wealth	-The job I am interested in. Doing the job, I love means not having to work at all - Each person should choose the job they like instead of going to work and hating the job they are not interested in -It is more important to do what you are interested in, money will come with persistence and resolution	-The job that provides financial security. -I'd opt for financial security, in case I couldn't have both - I think that one should consider the jobs that secure financial wealth	-Both are important. The whole package: to be interesting and well-paid -Doing the job you love is very important, but so is doing the one that is profitable -Both are important, the golden mean is desirable
Family and friends – influence	-I haven't been given any advice	-They wanted me to study something of their choice, not mine - We will be pleased with you only after you've enrolled in the studies that qualify you for an engineer (of any sort) -I've been advised by many, yet, all these pieces of advice are just their unfulfilled wishes	-I should make my own decision what to study, my happiness is the most important thing -Make your own choice in accordance with your skills and abilities -Study in order to learn the ways of the world. Study what you like".
Employment options	-The field of technology and engineering -Programmers find jobs most easily - The jobs related to computer science and programming are the easiest to find	-Medicine is equally prosperous as engineering - Anything related to sciences and mathematics. - Perhaps sciences, mathematics, physics, there is always a shortage of science teachers	/
The most prosperous jobs in Serbia and abroad	-I think that the computer-related professions are the most thriving jobs that are necessary in our country and abroad -I believe that the jobs in medicine, computer science and information technologies are the most prosperous here and abroad.	-The most prosperous jobs in our country are those related to sports, IT jobs are still developing. As regards other countries, it is biochemistry, medicine, engineering, technology and energetics -Software engineering, banking, auditing and law in our country. Medicine, software engineering, economy in other countries -The job that you are qualified for in our country, while abroad all jobs are well-paid	/



Research questions regarding the choice of academic studies	Category 1	Category 2	Category 3
Obstacles and limitations	<ul style="list-style-type: none"> -Money. The question is whether my studies will be state-funded, or I will have to pay tuition fees -Scholarship for studying abroad -Financial troubles. High tuition fees and living costs 	<ul style="list-style-type: none"> -I am troubled by the question whether that job will be satisfying for me, whether this field of science will be more prosperous in the future -The main obstacle is my being indecisive, I do not know what I am really interested in -I fear studying something I won't enjoy, or I fear not enrolling in any of the faculties 	<ul style="list-style-type: none"> -The only obstacle is the admission criterion that determines a small number of candidates to be accepted for this study programme -The number of admission points necessary for enrolment -Very strict admission criteria -Very competitive enrolment procedure -A small number of candidates to be admitted to this study programme -Very difficult entrance exam
Alternative employment	<ul style="list-style-type: none"> -I do not know, I haven't thought about that at all -No idea at the moment -I am not thinking about it right now, all I want is graduate and do the job I like 	<ul style="list-style-type: none"> -I would become an entrepreneur -I would start my own business, perhaps something related to design or manufacture of gluten-free goods -I would work with my parents in our family firm -In all likelihood, I will open a boutique -I would take a beautician training course, then I would find a job or open my own salon, and I think that I would be doing something I really like. You know, everyone likes talking to beauticians since they are good at keeping secrets and giving advice 	<ul style="list-style-type: none"> -I would work from home -I would offer mathematics tutoring -I would be a YouTuber -An English language translator -I would take up various hobbies, doing them at home, such as drawing on objects for everyday use, jars, boxes, glasses or I would try confectionery or astrology

Table 2 shows the frequency of the responses regarding preferred academic studies. The analysis presented in Table 2 proved that the majority of the respondents selected to enrol in social sciences and humanities ($f=89$), then medicine ($f=72$) and arts ($f=66$). However, regarding the fact that STEM education includes science, technology, engineering and mathematics, it is concluded that as many as 153 respondents selected to enrol in the study programmes that would qualify them for various STEM professions. More precisely, the majority of the students chose their major in technology ($f=62$), followed by sciences and mathematics ($f=53$). The least popular undergraduate major among the Serbian students was engineering ($f=38$). Out of 505 respondents, 48 of them said they were not going to enrol in this study programme.

Table 2
Respondents' Attitudes towards Academic Studies

	N	%
Natural sciences (mathematics, physics, biology, chemistry, geography)	53	10.5
Technology	62	12.3
Engineering	38	7.5
Medicine	72	14.2
Arts	66	13.0
Law	51	10.1
Physical education	26	5.1
Social sciences and humanities (pedagogy, psychology, sociology, philosophy, history, etc.)	89	17.6



	N	%
I do not want to go to university	48	9.5
Total	505	100

As regards gender, the research results proved that the female respondents preferred natural sciences ($f=32$), medicine ($f=61$), arts ($f=52$), law ($f=45$) and social sciences and humanities ($f=75$) while their male counterparts selected technology ($f=43$) and physical education ($f=16$). An equal number of female and male participants chose engineering ($f=19$). The differences in the subjects' responses were statistically significant regarding gender, $\chi^2=91.29$; $df=8$; $p=.001$.

Considering the school grade that the respondents attended during the research, the findings showed that the senior students predominantly selected natural sciences ($f=21$), technology ($f=15$) and engineering ($f=16$) whereas the first graders mainly opted for medicine ($f=21$), law ($f=25$), arts ($f=20$) and physical education ($f=8$). Moreover, social sciences and humanities proved to be more popular among the younger students ($f=30$) than among the seniors ($f=20$). The differences in the subjects' responses were statistically significant regarding school grade, $\chi^2=69.34$; $df=24$; $p=.001$.

With respect to academic achievement, the research findings undoubtedly proved that the students with higher academic achievement predominantly selected natural sciences ($f=44$), technology ($f=44$), engineering ($f=25$), medicine ($f=50$) and social sciences and humanities ($f=48$) while the students with lower academic achievement chose arts ($f=38$), law ($f=35$) and physical education ($f=20$). The differences in the subjects' responses were statistically significant regarding academic achievement, $\chi^2=168.34$; $df=34$; $p=.001$.

The presented data proved that the participants' responses were heterogeneous with reference to the respondents' demographic characteristics.

Table 3

Statistically Significant Differences Regarding Gender, School Grade and Academic Achievement

	χ^2	df	p
Gender	91.29	8	.001
School grade	69.34	24	.001
Academic achievement	168.34	32	.001

Table 4 shows the frequency of the responses regarding the students' professional preferences. The Crosstabs procedure was used to determine the frequency of the responses. The analysis of the results presented in table confirmed that the jobs in the fields of medicine ($f=76$), police, military, national security ($f=74$), information technologies ($f=66$) and art ($f=62$) were the most desirable professions selected by the majority of the Serbian students who participated in this research. A considerably smaller number of the students would choose jobs in the fields of law ($f=32$), sciences ($f=29$), foreign languages ($f=29$), architecture, civil engineering, occupational safety ($f=29$), education ($f=27$), journalism, public relations and management ($f=23$). Moreover, the study programmes offered in the fields of tourism ($f=16$), engineering ($f=16$), social work and care ($f=15$), banking and administration ($f=9$) and politics ($f=4$) proved to be the least popular among the students, i.e. the smallest number of the respondents would choose the career in these fields of study.

Table 4

Students' Professional Preferences

	N	%
Arts (acting, dance, painting, music, etc.)	62	12.3
Politics	4	0.8
Law	32	6.3



	N	%
Social work and social welfare	15	3.0
Medicine	76	15.0
Tourism	16	3.2
Education	27	5.3
Police, military, state security	74	14.6
Architecture, civil engineering and occupational safety	27	5.3
IT (Information technologies)	66	13.0
Engineering	16	3.2
Foreign languages	29	5.7
Banking and administration	9	1.8
Natural sciences (mathematics, physics, chemistry, biology, etc.)	29	5.7
Journalism and public relations, management	23	4.5
Total	100	100

With regard to gender, the research findings showed that the female students preferred the professions pertaining to the fields of arts ($f=45$), law ($f=30$), social work and social welfare ($f=15$), medicine ($f=64$), tourism ($f=12$), education ($f=26$), police and military ($f=44$), architecture ($f=15$), foreign languages ($f=25$), banking and administration ($f=6$), natural sciences ($f=19$) and journalism ($f=18$) whereas their male counterparts selected politics ($f=4$), IT professions ($f=48$) and engineering ($f=11$). The differences in the subjects' responses were statistically significant regarding gender, $\chi^2=115.19$; $df=14$; $p=.001$.

Moreover, the results exhibited that the senior students selected the professions in the fields of arts (third grade $f=18$, fourth grade $f=16$), technology (third grade $f=19$, fourth grade $f=20$), engineering (third grade $f=8$, fourth grade $f=4$), tourism (third grade $f=1$, fourth grade $f=10$), foreign languages (third grade $f=10$, fourth grade $f=7$), natural sciences (third grade $f=5$, fourth grade $f=10$), management and public relations (third grade $f=9$, fourth grade $f=3$) whereas the younger students preferred the professions pertaining to the fields of politics (first grade $f=1$, second grade $f=3$), law (first grade $f=16$, second grade $f=5$), medicine (first grade $f=22$, second grade $f=23$), social work and social welfare (first grade $f=4$, second grade $f=6$), police (first grade $f=22$, second grade $f=14$), architecture (first grade $f=7$, second grade $f=9$). The differences in the subjects' responses were statistically significant regarding the school grade, $\chi^2=74.00$; $df=42$; $p=.002$.

With respect to academic achievement, the students with lower academic achievement preferred the professions in the fields of politics ($f=2$) whereas those with higher academic achievement selected law (very good $f=20$, excellent $f=11$), social work (very good $f=9$, excellent $f=5$), medicine (very good $f=21$, excellent $f=49$), architecture (very good $f=7$, excellent $f=16$), IT (very good $f=15$, excellent $f=37$), engineering (very good $f=7$, excellent $f=7$) and journalism (very good $f=6$, excellent $f=13$). The differences in the subjects' responses were statistically significant regarding academic achievement, $\chi^2=90.88$; $df=56$; $p=.002$.

Table 5

Differences in the Subjects' Responses Regarding Gender, School Grade and Academic Achievement

	χ^2	df	p
Gender	115.10	14	.001
School grade	74.00	42	.002
Academic achievement	90.88	56	.002

Table 6 presented the results of the descriptive statistics, i.e. the respondents' average response obtained by valuing the items (M) and standard deviation (SD).

The analysis of the average response proved that the predominant motives governing the students' choice of academic studies were acknowledgment of their own interests and abilities ($M=4.42$, $SD=0.89$), and potential



employment and prosperous career in the selected field of study ($M=4.17$, $SD=1.04$). Also, the research results showed that profitable profession ($M=3.93$, $SD=1.16$) and financial status of the family ($M=4.01$, $SD=1.20$) considerably influenced the students' choice of future academic studies. Contrary to this, the research results proved that the respondents were uncertain to determine whether the advice obtained from family and friends ($M=3.45$, $SD=1.19$) and the status of state-funded or self-funded student ($M=3.10$, $SD=1.36$) influenced their decision and motivation for selecting a desired study programme.

Despite the fact that the respondents partially disagreed with the statements *My decision is based on the information that a degree in sciences and technology will most likely secure employment* ($M=2.86$, $SD=1.35$) and *My decision is based on the information that a degree in social sciences and humanities will most likely secure employment* ($M=2.36$, $SD=1.16$), the average response analysis proves that the respondents believed that a degree in sciences and technology would most probably secure employment in the labour market.

Table 6*Motives for the Choice of Academic Studies*

	<i>M</i>	<i>SD</i>
My choice is based on my own interests and abilities	4.42	.89
My choice is largely dependent on potential employment and prosperous career in the selected field of study	4.17	1.04
My decision depends on how profitable profession I will have after graduation	3.93	1.16
My decision depends on the financial status of my family	4.01	1.20
My choice of studies is governed by the advice obtained from family and friends	3.45	1.19
My decision is determined by the fact whether my studies will be state-funded, or I will have to pay tuition fees	3.10	1.36
My decision is based on the information that a degree in sciences and technology will most likely secure employment	2.86	1.35
My decision is based on the information that a degree in social sciences and humanities will most likely secure employment	2.36	1.16

Table 7 presented statistically significant differences in the respondents' responses regarding their gender, which were determined by the *t*-test. The analysis of the research results shown in Table 2 proved that the female students acknowledged the importance of their own interests and abilities when selecting their future academic studies ($M=4.53$, $SD=0.83$) more than their male counterparts ($M=4.17$, $SD=0.98$), who, on the other hand, favoured the advice obtained by family and friends ($M=3.35$, $SD=1.15$) more than the female respondents ($M=3.65$, $SD=1.24$).

The analysis of the average response proves that the status of the state-funded or self-funded student was more important for the male respondents ($M=3.41$, $SD=1.19$) than for their female counterparts ($M=2.96$, $SD=1.41$).

Table 7*Differences in the Students' Motives Regarding Gender*

	<i>Gender</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>
My choice is based on my own interests and abilities	Female	4.53	.83	4.02	274.80	.001
	Male	4.17	.98			
My decision is governed by the advice obtained from family and friends	Female	3.35	1.15	-2.62	503	.009
	Male	3.65	1.24			
My decision is determined by the fact whether my studies will be state-funded, or I will have to pay tuition fees	Female	2.96	1.41	-3.50	503	.001
	Male	3.41	1.19			



Table 8 presented statistically significant differences observed in the respondents' attitudes as regards their school grade, determined by the F test. The average response analysis emphasises the following tendency: the knowledge about a potential employment secured by a degree in sciences and technology increases with school grade. To be more precise, the students attending the first grade of secondary school at the time of the research displayed disagreement with this item ($M=2.50$, $SD=1.33$), unlike the fourth grade students, who displayed uncertainty in their evaluation ($M=3.02$, $SD=1.38$).

Table 8
Differences in the Students' Motives Regarding School Grade

	Grade	M	SD	F	df	p
My decision is based on the information that a degree in sciences and technology will most likely secure employment	First	2.50	1.33	4.30	3	.005
	Second	2.99	1.34			
	Third	2.96	1.32			
	Fourth	3.02	1.38			

Table 9 presented statistically significant differences observed in the respondents' attitudes regarding the students' academic achievement, determined by the F test. The average response analysis proved that the students with higher academic achievement (very good: $M=4.48$, $SD=0.79$ and excellent: $M=4.57$, $SD=0.76$) favoured their own interests and abilities when selecting their undergraduate majors when compared to the students with lower academic achievement, who displayed uncertainty when expressing their attitude to the statement *My choice is based on my own interests and abilities* (insufficient: $M= 3.00$, $SD= 1.22$, sufficient: $M=3.00$, good: $M=3.55$, $SD=1.22$). Moreover, potential employment and prosperous career in the selected field of study appeared to be more important for the students with higher academic achievement than for their less successful counterparts (insufficient: $M=3.80$, $SD= 0.83$, excellent: $M= 4.38$, $SD=0.94$).

However, the research results also showed that profitable profession after graduation was the most important motive for the students whose academic achievement was graded as sufficient ($M=5.00$). On the other hand, the students with good ($M=3.51$, $SD=1.38$), very good ($M=3.83$, $SD=1.21$) and excellent ($M=4.07$, $SD=1.06$) grades were either uncertain about this statement or partially disagreed with it.

The research results proved that the advice obtained from family and friends was not of crucial importance for the students' preferences. Actually, the students with lower academic achievement (insufficient: $M=2.60$, $SD=1.67$ and sufficient: $M=2.00$) disagreed with the statement *My choice of studies is governed by the advice obtained from family and friends*, whereas the students with higher academic achievement displayed uncertainty regarding this statement (good: $M=3.44$, $SD=1.22$, very good: $M=3.30$, $SD=1.27$ and excellent: $M=3.57$, $SD=1.10$).

The average response analysis demonstrated that the students with the lowest academic achievement observed that a degree in sciences and technology would most likely secure employment in the labour market ($M=4.40$, $SD=0.54$). On the contrary, other respondents displayed either disagreement or uncertainty regarding this statement. Similarly, the research results showed that the students with better academic achievement disagreed with the statement that a degree in social sciences and humanities would secure employment in that field of study. Again, only the students with the lowest academic achievement partially agreed with the statement *My choice is based on the information that a degree in social sciences and humanities will most likely secure employment* ($M=4.00$, $SD=1.00$).

The ensuing part of the research assessed the students' attitudes towards scientific disciplines within STEM education, and towards potential professions in the fields of science, mathematics, engineering and technology.



Table 9*Differences in the Students' Motives Regarding Academic Achievement*

	Academic achievement	M	SD	F	df	p
My choice is based on my own interests and abilities	Insufficient	3.00	1.22	19.94	4	.001
	Sufficient	3.00	.			
	Good	3.55	1.22			
	Very good	4.48	.79			
	Excellent	4.57	.76			
My choice is largely dependent on potential employment and prosperous career in the selected field of study	Insufficient	3.80	.83	5.97	4	.001
	Sufficient	4.00	.			
	Good	3.83	1.08			
	Very good	3.97	1.11			
	Excellent	4.38	.94			
My decision depends on how profitable profession I will have after graduation	Insufficient	4.00	1.00	3.19	4	.013
	Sufficient	5.00	.			
	Good	3.51	1.38			
	Very good	3.83	1.21			
	Excellent	4.07	1.06			
My choice of studies is governed by the advice obtained from family and friends	Insufficient	2.60	1.67	2.40	4	.049
	Sufficient	2.00	.			
	Good	3.44	1.22			
	Very good	3.30	1.27			
	Excellent	3.57	1.10			
My decision is based on the information that a degree in sciences and technology will most likely secure employment	Insufficient	4.40	.54	5.69	4	.001
	Sufficient	3.00	.			
	Good	2.91	1.18			
	Very good	2.53	1.24			
	Excellent	3.04	1.41			
My decision is based on the information that a degree in social sciences and humanities will most likely secure employment	Insufficient	4.00	1.00	2.90	4	.021
	Sufficient	1.00	.			
	Good	2.36	1.13			
	Very good	2.36	1.20			
	Excellent	2.33	1.12			

The average response analysis proved that the respondents (505) considered science to be not so fascinating ($M=2.40$, $SD=1.29$), attractive ($M=2.58$, $SD=1.33$) and exciting ($M=2.50$, $SD=1.30$), since their responses were mainly concentrated around number 2 on the scale ranging from number 1 (fascinating, attractive and exciting) to number 4 (common, unattractive and unexciting). Also, the research results showed that the students found science not so important ($M=3.65$, $SD= 1.11$) and interesting ($M=3.71$, $SD= 1.19$).



Table 10
Students' Attitudes towards Science

	<i>M</i>	<i>SD</i>
SCIENCE is: fascinating – common	2.40	1.29
SCIENCE is: attractive – unattractive	2.58	1.33
SCIENCE is: exciting – unexciting	2.50	1.30
SCIENCE is: totally unimportant – very important	3.65	1.11
SCIENCE is: boring – interesting	3.71	1.19

The research results showed that the students considered mathematics to be fairly boring ($M=2.68$, $SD=1.48$), unattractive ($M=3.40$, $SD=1.43$), common ($M=3.20$, $SD=1.36$) and unexciting ($M=3.48$, $SD=1.33$). In line with these findings, the respondents expressed their view of mathematics as being a fairly important branch of science ($M=3.04$, $SD=1.35$).

Table 11
Students' Attitudes towards Mathematics

	<i>M</i>	<i>SD</i>
MATHEMATICS is: boring – interesting	2.68	1.48
MATHEMATICS is: attractive – unattractive	3.40	1.43
MATHEMATICS is: fascinating – common	3.20	1.36
MATHEMATICS is: exciting – unexciting	3.48	1.33
MATHEMATICS is: totally unimportant – very important	3.04	1.35

The average response analysis showed that the majority of the students considered engineering to be unattractive ($M=3.48$, $SD=1.39$), common ($M=3.28$, $SD=1.32$), unexciting ($M=3.38$, $SD=1.31$) and boring ($M=2.67$, $SD=1.35$), rather than attractive, fascinating, exciting and interesting. In addition, the research results proved that engineering was not an important branch of science for the respondents ($M=2.65$, $SD=1.29$).

Table 12
Students' Attitudes towards Engineering

	<i>M</i>	<i>SD</i>
ENGINEERING is: attractive – unattractive	3.48	1.39
ENGINEERING is: fascinating – common	3.28	1.32
ENGINEERING is: totally unimportant – very important	2.65	1.29



	<i>M</i>	<i>SD</i>
ENGINEERING is: exciting – unexciting	3.38	1.31
ENGINEERING is: boring – interesting	2.67	1.35

The research results confirmed that the students considered technology, as one of the STEM scientific disciplines, to be fairly attractive ($M=2.72$, $SD=1.45$), important ($M=3.58$, $SD=1.31$), interesting ($M=3.42$, $SD=1.35$), exciting ($M=2.77$, $SD=1.36$) and fascinating ($M=2.60$, $SD=1.36$).

Table 13
Students' Attitudes towards Technology

	<i>M</i>	<i>SD</i>
TECHNOLOGY is: Attractive – unattractive	2.72	1.45
TECHNOLOGY is: totally unimportant – very important	3.58	1.31
TECHNOLOGY is: boring – interesting	3.42	1.35
TECHNOLOGY is: exciting – unexciting	2.77	1.36
TECHNOLOGY is: fascinating – common	2.60	1.36

The average response analysis indicated that the students assumed that career in science, technology, engineering and mathematics was fairly important ($M=3.06$, $SD=1.38$) and interesting ($M=2.98$, $SD=1.32$). On the other hand, most of the respondents found career in the STEM field unexciting ($M=3.09$, $SD=1.28$), common ($M=2.95$, $SD=1.25$) and unattractive ($M=3.09$, $SD=1.34$).

Table 14
Students' Attitudes towards STEM Career

	<i>M</i>	<i>SD</i>
CAREER in science, technology, engineering or mathematics is: totally unimportant – very important	3.06	1.38
CAREER in science, technology, engineering or mathematics is: boring – interesting	2.98	1.32
CAREER in science, technology, engineering or mathematics is: exciting – unexciting	3.09	1.28
CAREER in science, technology, engineering or mathematics is: fascinating – common	2.95	1.25
CAREER in science, technology, engineering or mathematics is: attractive – unattractive	3.09	1.34



Discussion

The analysis of the qualitative results shows that the students decided about their further education upon graduating from secondary school and during secondary school in most of the cases. Also, their choices were predominantly influenced by their own ambitions and preferences (interests, personal satisfaction, love of certain professions and ability to do certain jobs), or they were determined by employment prospects in the labour market. Actually, the students who participated in the research emphasised financial gain and easy employment after graduation rather often. Moreover, the research results confirmed that the students were frequently prone to changing their decisions regarding the choice of undergraduate majors, the reasons being related to their indecisiveness and uncertainty about their own choices, changed interests over time, influence of the surrounding, the fact that the chosen profession became less recognised in society and difficulty in finding employment in their field of study. A longitudinal research with 12-to-16-year-old students concluded that attitudes towards STEM and career interests became evident at the age of thirteen and it became more difficult to engage students in STEM-related activities at later ages (Lindahl, 2007, in Zhou et al., 2019).

The students were also asked whether it was more important to do the job they liked or the one that would secure financial wealth and stability. The results confirmed that one group of the students thought that love of profession meant greater accomplishments and personal satisfaction, while the other one believed that frequent financial crises and a poor state of the national economy demanded that they choose prosperous professions as dictated by the labour market. The third group of the students emphasised the necessity to find a balance and the "golden mean" when selecting a profession that would be both profitable and in accordance with their personal interests and preferences. As regards the advice offered by family and friends, the research results show three alternatives: lack of advice, imposing decisions on the students (imposing one's own attitudes and unfulfilled dreams on the students, recommendation of prospering studies that would secure easy employment, a stable job and a good salary) and insistence on the students' individual and independent choices accorded with their personal ambitions (general support, advice to ignore other people's opinion and acknowledge only their own happiness, wishes and abilities). The research results obtained by interviewing the respondents show beyond any doubt that the students decided that STEM professions were the most prosperous in the labour market, and that they were aware of the fact that young qualified experts could easily find jobs in the fields of technology, engineering, science and medicine. When it comes to the issue of the most prospering jobs in Serbia and abroad, the research results show that the IT sector and medicine were regarded as the most profitable professions. However, the students often emphasised that the main differences were reflected in the fact that the majority of the professions which were not from the STEM field were still marginalised in Serbia, while the situation abroad was much better because of greater possibilities for employment in any sector. Regarding the obstacles the students encountered when deciding about their academic studies, the research results show that they were mainly financial problems (high tuition fees, costly accommodation and expensive students' life), personal barriers (indecisiveness and uncertainty about their own choices, fear of making a wrong choice, fear of failing to enrol in the faculty of their own liking or fear of low achievement during studies) and obstacles related to the characteristics of the academic studies and faculties themselves (training that does not guarantee employment, competitive studies, difficult entrance exam, admission criteria that allow a small number of candidates to be admitted, a great number of applicants, strict admission criteria). The responses to the question related to alternative jobs that the respondents would do in case they failed to find a job in their field of study indicate that the students would start their own business or work from home.

Based on the aforementioned, the first hypothesis was confirmed: *It is supposed that the students' choice of academic studies and future profession is based on their own ambitions, potential employment and financial wealth to be provided by their selected profession, and that they consider STEM professions to be the most prospering in the labour market.*

The analysis of the quantitative research results, obtained by scaling and surveys, indicates that the students were interested in enrolling in the faculties with majors in the STEM field. Namely, the research determined that the students were most interested in studying technology and sciences, while they considered engineering to be the least popular branch of science within the STEM field. Also, the research results prove that a large number of the respondents chose medicine as their preferred major. The presented results confirmed the hypothesis: *It is assumed that the students primarily enrol in the studies of sciences (mathematics, physics, biology, chemistry, geography), technology and engineering.*

Analysing the respondents' motives for selecting a desired field of study, it is concluded that they were mainly based on the students' abilities and interests, future employment, prospering professions, potentially well-paid jobs and



the financial status of the family. However, the research results show that the advice obtained from family and friends was not crucial in the students' selection of the preferred studies. These results confirmed the research hypothesis: *It is presumed that the students' primary motives for selecting a desired field of study are related to the possibilities of easy employment and finding a prosperous job.*

Prior studies have recognised a few important factors that influence students' interest in STEM careers. For example, student's own self-motivation, the quality of science and mathematics courses offered at school, parents, teachers, and school-related factors have all been shown to have either direct and/or indirect influence (Halim et al., 2018; Kauffmann et al., 2009, in Mohtar et al., 2019).

Considering the gender differences, the research results demonstrate that the female students displayed intrinsic motivation when selecting their majors (acknowledgement of their own interests and abilities), unlike their male counterparts, who primarily expressed extrinsic motivation (obeying advice obtained from family and friends). The analysis of the responses of the students of different ages proves that the students who attended higher school grades were more informed about employment possibilities in the labour market provided by a degree in sciences and mathematics. Considering the attitudes of the students with different levels of academic achievement, the research results show that the students with high academic achievement considerably valued their own interests and abilities, as well as the choice of a prosperous profession. Unlike them, the students with low academic achievement stated that their preferences were based on the financial gain to be provided by their potential professions.

The assumption that Serbian students are interested in the professions in the IT sector, social work and foreign languages was partially confirmed. Namely, the research results prove that one fifth of the respondents preferred a profession in the domain of the STEM field. To be more precise, the majority of the students would gladly accept a job in the fields of technology and medicine, while engineering appeared to be the least popular branch of science when it comes to the STEM scientific disciplines. The results of a research (Suprpto, 2016) indicated that mathematics became the dominant preference among students, followed by science compared to technology and engineering or STEM itself. This result presented that mathematics occupied larger space in secondary school curricula. Another research conducted by Özgün-Koca and Şen (2011) on the sample comprised of Turkish secondary school students showed that they had positive attitudes towards mathematics and science.

Students should be exposed to real life STEM workers in order to give them understanding about STEM job prospects and the required skills in STEM fields. Thus, schools have to collaborate with universities and industries. Accordingly, the STEM mentor-mentee programme should be implemented in order to engage more students in STEM trajectories (Mohtar et al., 2019).

The analysis of the respondents' attitudes to STEM education shows that the students considered science, mathematics, technology and engineering to be important scientific disciplines. However, the research findings also prove that the students evaluated technology and science more positively, regarding them as fascinating, attractive, exciting and interesting, than engineering and mathematics, which were assessed as fairly boring, unattractive, common and unexciting. The stated results confirmed the hypothesis: *It is assumed that the Serbian students assess science and technology more positively than mathematics and engineering.*

Conclusions and Implications

The value of this research is reflected in the fact that the research studies of the perspectives of STEM education and professions in Serbia are rare. The research results prove that the respondents displayed both intrinsic and extrinsic motives when deciding about their preferred field of study. In fact, the students' professional choices were based on their need to satisfy personal ambitions, interests, wishes and abilities, but also to secure financial stability by selecting a prosperous profession. The research also shows that a poor state of the national economy and failure to get employed in the field of study largely influenced the students' decision to change their choices and enrol in the studies that would qualify them for the "jobs of the future". Actually, the students were inclined to select training that would secure employment, a good salary and financial stability. The research results undoubtedly show that the students considered the professions in the IT sector, engineering, sciences and medicine to be the most profitable ones in contemporary society. The aforementioned facts undeniably prove that almost one half of the respondents were determined to enrol in the studies pertaining to the STEM field or medicine, and that they preferred the professions from the domain of the STEM academic studies.

The research results confirm the growing popularity of STEM professions among the Serbian students. Moreover, the research determined that the students thought that the STEM field encompassed some of the most thriving



ing and most popular professions in the world. However, the research data indicate a further necessity to promote mathematics and engineering since the students rarely chose these majors as preferable and mainly regarded these disciplines as less exciting, fascinating, attractive and interesting than technology and science.

The research results prove that Serbian secondary school students are interested in and motivated for STEM careers. Therefore, some further research in this field might include primary school students, university students and university teachers and experts with the purpose of examining their attitudes to STEM careers. These studies would offer a more comprehensive reflection of this significant issue. This particular research may initiate similar and relevant studies related to STEM education.

Acknowledgements

Prepared as a part of the project “Pedagogical Pluralism as the Foundation of the Education Strategy”, financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia (No. 179036, 2011-2020).

References

- Alberts, C., Mbalo, N. F., & Ackermann, C. J. (2003). Adolescents' perceptions of the relevance of domains of identity formation: A South African cross-cultural study. *Journal of Youth and Adolescence*, 32(3), 169-184. <https://link.springer.com/article/10.1023/A:1022591302909>
- Baram-Tsabari, A., Sethi, R. J., Bry, L., & Yarden, A. (2009). Asking scientists: A decade of questions analyzed by age, gender, and country. *Science Education*, 93(1), 131-160. <https://onlinelibrary.wiley.com/doi/pdf/10.1002/sce.20284>
- Capobianco, B. M., Diefes-dux, H. A., Mena, I., & Weller, J. (2011). What is an engineer? Implications of elementary school student conceptions for engineering education. *Journal of Engineering Education*, 100(2), 304-328. <https://onlinelibrary.wiley.com/doi/abs/10.1002/j.2168-9830.2011.tb00015.x>
- Creed, P. A., & Patton, W. (2003). Differences in career attitude and career knowledge for high school students with and without paid work experience. *International Journal for Educational and Vocational Guidance*, 3(1), 21-33. link.springer.com/article/10.1023/A:1022674528730
- English, L. D. (2016). STEM education K-12: Perspectives on integration. *International Journal of STEM Education*, 3(3), 1-8. <https://link.springer.com/article/10.1186/s40594-016-0036-1>
- Ertl, B., Luttenberger, S., & Paechter, M. (2017). The impact of gender stereotypes on the self-concept of female students in STEM subjects with an under-representation of females. *Frontiers in Psychology*, 8, 703. <https://doi.org/10.3389/fpsyg.2017.00703>
- Fouad, N. A., Hackett, G., Smith, P. L., Kantamneni, N., Fitzpatrick, M., Haag, S., & Spencer, D. (2010). Barriers and supports for continuing in mathematics and science: Gender and educational level differences. *Journal of Vocational Behavior*, 77(3), 361-373. <https://doi.org/10.1016/j.jvb.2010.06.004>
- Fuselier, L., & Jackson, J. K. (2010). Perceptions of collaboration, equity and values in science among female and male college students. *Journal of Baltic Science Education*, 9(2), 109-118. <http://oaji.net/articles/2014/987-1405171377.pdf>
- Griffee, D. T. (2005). Research tips: Interview data collection. *Journal of Developmental Education*, 28(3), 36-37. <https://eric.ed.gov/?id=EJ718580> <https://files.eric.ed.gov/fulltext/EJ718580.pdf>
- Hossain, M., & Robinsom, G. M. (2012). How to motivate US students to pursue STEM (science, technology, engineering and mathematics) careers. *US-China Education Review A*, 4, 442-451. <https://eric.ed.gov/?id=ED533548> <https://files.eric.ed.gov/fulltext/ED533548.pdf>
- Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, 33(7), 14-26. <https://doi.org/10.3102/0013189X033007014>
- Kelley, T. R., & Knowles, J. G. (2016). A conceptual framework for integrated STEM education. *International Journal of STEM Education*, 3(11), 1-11. <https://stemeducationjournal.springeropen.com/articles/10.1186/s40594-016-0046-z>
- Kennedy, T. J., & Odell, M. R. L. (2014). Engaging students in STEM education. *Science Education International*, 25(3), 246-258. <https://eric.ed.gov/?id=EJ1044508>
- Kier, M. W., Blanchard, M. R., Osborne, J. W., & Albert, J. L. (2014). The development of the STEM career interest survey (STEM-CIS). *Research in Science Education*, 44(3), 461-481. <https://link.springer.com/article/10.1007/s11165-013-9389-3>
- Kitts, K. (2009). The paradox of middle and high school students' attitudes towards science versus their attitudes about science as a career. *Journal of Geoscience Education*, 57(2), 159-164. <https://doi.org/10.5408/1.3544253>
- Kniveton, B. H. (2004). The influences and motivations on which students base their choice of career. *Research in Education*, 72(1), 47-59. <https://journals.sagepub.com/doi/abs/10.7227/RIE.72.4?journalCode=riea>
- Luttenberger, S., Paechter, M., & Ertl, B. (2019). Self-concept and support experienced in school as key variables for the motivation of women enrolled in STEM subjects with a low and moderate proportion of females. *Frontiers in Psychology*, 10, 1242. <https://doi.org/10.3389/fpsyg.2019.01242>
- Miller, L., Lietz, P., & Kotte, D. (2002). On decreasing gender differences and attitudinal changes: Factors influencing Australian and English pupils' choice of a career in science. *Psychology, Evolution & Gender*, 4(1), 69-92. <https://www.tandfonline.com/doi/abs/10.1080/1461666021000013670>



- Mohtar, L. E., Halim, L., Rahman, N. A., Maat, S. M., Iksan, Z. H., & Osman, K. (2019). A model of interest in stem careers among secondary school students. *Journal of Baltic Science Education*, 18(3), 404-416. http://www.scientiasocialis.lt/jbse/files/pdf/vol18/404-416.Mohtar_JBSE_Vol.18_No.3.pdf
- Özgün-Koca, S., & Şen, A. İ. (2011). Evaluation of beliefs and attitudes of high school students towards science and mathematics courses. *Journal of Turkish Science Education*, 8(1), 42-60. <http://www.tused.org/index.php/tused/article/view/547>
- Stout, J. G., Dasgupta, N., Hunsinger, M., & McManus, M. A. (2011). STEMing the tide: Using ingroup experts to inoculate women's self-concept in science, technology, engineering, and mathematics (STEM). *Journal of Personality and Social Psychology*, 100(2), 255-270. <https://psycnet.apa.org/record/2010-25580-001>
- Suprpto, N. (2016). Students' attitudes towards STEM education: Voices from Indonesian junior high schools. *Journal of Turkish Science Education*, 13(special), 75-87. <http://www.tused.org/index.php/tused/article/view/624>
- Taylor, J., Harris, M. B., & Taylor, S. (2004). Parents have their say... about their college-age children's career decisions. *Nace Journal*, 64(2), 15-21. https://www.fredonia.edu/sites/default/files/section/student-life/career-development-office/_files/parents_say.pdf
- Thomas, T., & Allen, A. (2006). Gender differences in students' perceptions of information technology as a career. *Journal of Information Technology Education: Research*, 5(1), 165-178. <https://www.learntechlib.org/p/111539/>
- Tyler-Wood, T., Knezek, G., & Christensen, R. (2010). Instruments for assessing interest in STEM content and careers. *Journal of Technology and Teacher Education*, 18(2), 345-368. <https://www.learntechlib.org/p/32311/>
- Van der Gaag, M. A., & Van den Berg, P. (2017). Modelling the individual process of career choice. In W. Jager, R. Verbrugge, A. Flache, L. Hoogduin, & G. De Roo (Eds.) *Advances in social simulation 2015. Advances in intelligent systems and computing* (pp.435-444). Springer, Cham. https://link.springer.com/chapter/10.1007/978-3-319-47253-9_40
- Wilgosh, L. (2002). Examining gender images, expectations, and competence as perceived impediments to personal, academic and career development. *International Journal for the Advancement of Counselling*, 24(4), 239-260. <https://link.springer.com/article/10.1023/A:1023320813239>
- Wyss, V. L., Heulskamp, D., & Siebert, C. J. (2012). Increasing middle school student interest in STEM careers with videos of scientists. *International Journal of Environmental and Science Education*, 7(4), 501-522. <https://eric.ed.gov/?id=EJ997137>
- Yıldırım, B., & Sidekli, S. (2018). STEM applications in mathematics education: The effect of stem applications on different dependent variables. *Journal of Baltic Science Education*, 17(2), 200-2014. <http://www.scientiasocialis.lt/jbse/?q=node/652>
- Zhou, S. N., Zeng, H., Xu, S. R., Chen, L. C., & Xiao, H. (2019). Exploring changes in primary students' attitudes towards science, technology, engineering and mathematics (STEM) across genders and grade levels. *Journal of Baltic Science Education*, 18(3), 466-480. <https://www.stat.gov.rs/en-US/oblasti/obrazovanje/srednje-obrazovanje>

Received: July 15, 2020

Accepted: November 22, 2020

Cite as: Maksimović, J. Ž., Osmanović, J. S., & Mamutović, A. S. (2020). Perspectives of STEM education regarding Serbian secondary school students' motivation for career choice. *Journal of Baltic Science Education*, 19(6), 989-1007. <https://doi.org/10.33225/jbse/20.19.989>

Jelena Ž. Maksimović

PhD, Associate Professor, Department of Pedagogy, University of Niš, Ćirila i Metodija 2, 18 000 Niš, Serbia.
E-mail: jelena.maksimovic@filfak.ni.ac.rs
Website: <https://www.filfak.ni.ac.rs/nastavno-osoblje/pedagogija/item/137-jelena-maksimovic>
ORCID: <https://orcid.org/0000-0001-8356-0211>

Jelena S. Osmanović
(Corresponding author)

Teaching Assistant, Department of Pedagogy, University of Niš, Ćirila i Metodija 2, 18 000 Niš, Serbia.
E-mail: jelena.osmanovic@filfak.ni.ac.rs
Website: <https://www.filfak.ni.ac.rs/nastavno-osoblje/pedagogija/item/143-jelena-osmanovic>
ORCID: <https://orcid.org/0000-0002-2289-9438>

Anastasija S. Mamutović

Teaching Assistant, Department of Pedagogy, University of Niš, Ćirila i Metodija 2, 18 000 Niš, Serbia.
E-mail: anastasija.mamutovic@filfak.ni.ac.rs
<https://www.filfak.ni.ac.rs/nastavno-osoblje/pedagogija/item/906-anastasija-mamutovic>
ORCID: <https://orcid.org/0000-0001-8214-9842>

