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STEM EDUCATION IN TEACHING GEOGRAPHY IN BOSNIA AND HERZEGOVINA

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Abstract
The aim of this paper is to support the change of STEM education in Bosnia and Herzegovina within the education programmes. Geography relates to STEM disciplines through the application of geography tools for problem solving. Geography strongly connects STEM (science, technology, engineering, and mathematics) disciplines using geographic technology/ tools that may offer better understanding of inter-disciplinary occurrences for solving important problems. With an aim to offer a holistic image of higher geographic education relating to STEM education in Bosnia and Herzegovina. The results of this research support the benefits to education based on the economics of knowledge of geography programmes, as well as other disciplines. This process could be modeled in countries that have chosen to participate in the development of STEM disciplines. Within the research, an overview of basic indicators and trends in STEM education was given, as well as an evaluation of quality of the education system in Bosnia and Herzegovina. In this paper, conduction of the primary research is planned and it will include questionnaires and semi-structured interviews with the population and persons responsible for scientific innovations in education.

Key words
STEM, geography major, science, geography, education.

INTRODUCTION

In the past several years, governments of developed countries throughout the world have put a special emphasis on improving quality of education in technology and geography areas (STEM). This sustains a critical important of STEM disciplines for a modern society. STEM represents an integration, interdisciplinary and trans-disciplinary approach – integration between subjects, a uniqueness of knowledge that produces coherence. Science and geography provide answers to foundational questions of nature and they enable us to get familiar with the world around us. Expertise in STEM disciplines should encourage our economic ambitions, support innovations and ensure foundations for future prosperity of youth in primary and secondary schools. Economies based on knowledge in Bosnia and Herzegovina are especially dependent on quality and quantity of STEM graduates. Bosnia and

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Herzegovina, for research and development, science and technology, emphasizes a critical importance of the excellence of STEM education in order to ensure a continuing development of economic activities and talents to support foreign direct investments and an active ecosystem for domestic companies. Preparation of this report was founded on expertise of many individuals and organizations in the USA and the European Union. Significant consultation with a wide spectrum of interested parties were included. Besides providing their expertise of members of the audit group, the members were asked to contribute to public, academic and education institutions, as well as, the professionals in the education sectors along with their representative bodies (Dweck, Walton, & Cohen, 2014; Sharples, 2000).

University of Prešov is the only one of the above universities to have fully implemented the new paradigm within tertiary Geography education. It is also the only one to have created a modular study programme. The whole process of implementation was divided into different stages. At the beginning there was lengthy discussion between course guarantors and key stakeholders working in the areas of tourism, regional development and land management from which it became clear that new study programmes should consider not just the new university education paradigm but also other factors. The aim was to increase application of geospatial collection technology, cartographical interpretation and visualization of geographical data (Matlovič, Rene; Matlovičová, Kvetoslava, 2016).

In 2017 in Bosnia and Herzegovina, a new programme has started, education and education of teachers in primary and secondary schools with support of a development agency USAID and organization Save the Children in Sarajevo. I would especially like to emphasize that the office of Save the Children in Sarajevo and the support of professors from the USA who were engaged in STEM education in Bosnia and Herzegovina. I am looking forward to seeing their and our efforts transformed into significant improvements of the STEM experience for students in schools of Bosnia and Herzegovina. Led by these studies, and aware of solicitude expressed from a series of sources regarding quality and quantity of education, STEM in Bosnia and Herzegovina has an aim to develop innovation and creativity in primary and secondary schools. Preparation of this research was founded on expertise of many individuals in education and organizations (Md Rajibul Al Mamun1, Trisha Jackson1 & George White, 2015).

For the uninterested ones from Bosnia and Herzegovina, STEM is science, technology, engineering and mathematics, geography, chemistry, physics and economics, and these are the areas that many academic and political leaders in Bosnia and Herzegovina have evaluated as important for current and future growth of our economic area and area in which our students do not excel. Strengthening education in the STEM field in relevant sectors of economy based on knowledge in Bosnia and Herzegovina in primary, secondary and higher education is the most important for our global competitiveness in key people in education and

politics, that is, principals and supervisors of the education system. As a result of that, financing on all levels is increased for STEM, often with the price of support of other disciplines. Surely, we may challenge why these certain disciples and ways of knowing the world are extracted and gain attention and financing (as well as many others, especially in humanities), however, due to this short column, we wish to focus on the majority of reality. Here, we are currently faced with developing knowledge through STEM education in primary, secondary and higher education institutions.

Geography status, comparing to STEM, is ambiguous due to two main reasons. First, no one has synchronized with the national definition of that which connects specific fields of study relating to STEM. The Department of national security includes geographical information science and cartography as a STEM discipline (it is important in a sense of international student employment), while the national foundation for science includes geography in its list of disciplines that fulfill conditions for STEM funding of most of their competitions in the field of undergraduate education. Second, geography is a broad interdisciplinary discipline, which was mentioned in the first column as a radically interdisciplinary one.

METODS AND DATA SOURCES

Case study methods are used for deeper understanding the answers made by stakeholders about STEM during the workshop. Various methods were used in order to collect rich information about new understanding of teachers about this approach and questions relating to its implementation in real school contexts (Merriam, 1988. Yin, 2003). Implementation of the Bologna process led to the increased subordination of the European universities and higher education institutions to neoliberal values *(Matlovič, René; Matlovičová, Kvetoslava, 2017)*.

Participants from 40 public education institutions in Bosnia and Herzegovina were offered a possibility to send two teachers from various disciplines for STEM professional education. Finally, 35 education institutions sent their representatives for STEM education, and those have agreed to participate. (Nurković, R., 2012) Teachers that have registered included teachers of geography, mathematics, physics, biology, information technologies and homeroom. From those, 35 have completed all five days of education in the STEM programme. Teachers that have not completed the programme have named many reasons why they have not finished, including illnesses, child care issues, other conferences they wanted to participate in, and the quantity of time need to participate in those sessions. The data was collected through a) observations of participants in activities and discussions during the workshop for professional development, b) focus group discussions at the end of the workshop (60 min), c) individual interviews with 12 participants (both improvised and formal, in the duration from 15 to 20 min), and d) feedback about workshops and evaluation forms.

Besides the named, a survey was used prior to the workshop in order to research the understanding of participants and any other experiences relating to learning and based on STEP discipline problems. Multiple methods of data collection used during workshops have helped to monitor the reaction of participants to the interdisciplinary approach, as well as, their perception of numerous system challenges in using this approach in their current practice. Data on quantitative surveys were collected through a survey conducted at the beginning of the workshop in order to include starting conceptions of participants about the STEM programme and their previous experience and application in class *(Fontichiaro, K., & Elkordy, A. 2015)*.

Analytical strategies for data analysis have included coding interviews, focus groups and observational data. In the starting data analysis, we have followed the inductive approach in order to enable those codes to arise from data. Further, we used the constant comparative method according to (Lincoln & Guba, 1985) to organize data of broader categories and topics according to our research questions (for example, starting perceptions of teachers about learning in STEM education, implementation of challenges, system obstacles, etc.). Besides that, multiple discussions between members of the study team have enabled a deeper data analysis from multiple angles and they have helped in answering questions of validity relating to our interpretation of findings (Patton, 1990; Strauss, 1987; Strauss & Corbin, 1998). For data analysis of surveys, we have used descriptive statistical techniques. These discussions about main topics that have been revealed by our analysis, and their implications on development and implementation of efficient programmes for development of teachers using the interdisciplinary approach of STEM education, were analyzed. Our analyses revealed some interesting changes in conceptions of teachers about STEM education of teachers of various disciplines (Rothwell, 2013). Besides that, broad topics that have occurred were related to the implementation of the STEM approach and possible outcomes of such implementation in Bosnia and Herzegovina.

RELEVANT SECTORS OF ECONOMY BASED ON KNOWLEDGE

Conceptualizing the importance of geography, we must understand that what makes science relevant is shaped by the social context in which science is represented, interpreted and used (Matlovič, René; Matlovičová, Kvetoslava ,2017). The complexity of today's world requires that all people are equipped with the new set of basic knowledge and skills for solving complex problems, collecting and validating evidence, and creating a sense for information they gather from diverse and growingly digital media.(Nurkovic,R.,2018): Teaching and working of STEM helps in development of these skills and prepares students for work force where their success depends on what they know, as well as, what they are able to do with that knowledge. Therefore, a strong STEM education becomes growingly recognizable

as the key starter of possibilities, and the data show the need for STEM knowledge in Bosnia and Herzegovina, as well as, skills that will grow and continue to be needed in the future. As with all other aspects of education, the whole community plays the key role in the demonstration of the relevance and value of STEM in everyday life and in the promotion of exposure and fair approach to high-quality STEM learning experiences. Engaging the whole series of stakeholders and community members in the improvement of STEM education in certain sectors may help in relieving the behavioral, structural and organization factors that impact teaching and learning of the STEM practice, where they play a role in engaging or converting of certain student groups outside of STEM (Handelsman & Sakraney, 2015). Academic culture is substituted by the culture of auditing. Financing systems of universities adapt to the model of multisource financing which involves decreasing support from the public budgets and the profuse participation of private resources. Performance, contract and project funding is enforced. Such an approach stimulates commercialisation and commodification both in the area of education (maximisation of numbers of students) and in the area of research (orientation to marketable results or those applicable in the political/economic practice) (Matlovič, René; Matlovičová, Kvetoslava, 2017).

Despite many challenges relating to transformation of STEM education in Bosnia and Herzegovina, priority is placed on STEM education, including the past several years, to include public, private and secondary schools (Sanders, M. 2009) Foundation for education and science, USAID and Save the Children in Bosnia and Herzegovina also financed larger research regional centers, through which they offer a wide spectrum of educational and field activities. It also directly manages national projects, such as STEM education. Geography in primary schools is a unique component of the tri-dimensional part of the curricula, social, ecological and science education, which is made up of three subjects: science, geography and history. The suggested changes in the post-primary education have resulted in a way that STEM subjects are more focused on a deeper understanding of basic concepts, as well as, on the application of knowledge and understanding. Such programmes might be developed on a successful model of blended education, education for geography teachers that are not in the field. To sustain a strong programme in geography and information technologies is important since it is the foundation for STEM education. Within this research, there is an overview of basic indicators and trends in STEM education and quality evaluation of the education system in Bosnia and Herzegovina. Process of learning and practicing STEM disciplines may be adopted by students through the passion for researching, discovering and stimulating skills, such as perseverance, teamwork and application of gained knowledge in new situations (Bailey et al., 2015; Betrus, 2015). (Table 1 and 2).

Table 1 Relevant sectors of economy based on knowledge in Bosnia and Herzegovina, 2019.

FIELD 1: EARTH IN SPACE AS LIVING SPACE			
Component 2: Structure and functional connection between natural and geographical environment			
Outcome: 1. analyses natural processes and occurrences and their interaction using geographical terminology			
Differentiates and determines specificities of natural-geographical and socio-geographical characteristics of a certain geographical space.	Relevant sectors KBE	Explanation how an indicator relates to KBE sector	Closely connected study objectives relating to KBE sector
	10) Modern agricultural manufacturing 3) Technology of materials and high-tech manufacturing 9) Entrepreneurship 8) Tourism 2) Healthcare.	Present application of modern geographical studies connecting relevant sectors: Modern agricultural manufacturing, Technology of materials and high-tech manufacturing, Entrepreneurship, Tourism and Healthcare.	3. Determines the importance of functional changes in natural-geographical environment that occur during seasonal changes. 4. Analyses interaction between natural and geographical environment with a diversity of living beings.

Table 2 Number of fields, components, study objectives for STEM subjects per programs. in Bosnia and Herzegovina, 2019.

Subject	Number of fields	Number of components	Number of study objectives	Number of indicators at the end of secondary education
Geography	4	16	49	144

Source: *http://www.fipa.gov.ba/ local_v2 / default_bs.asp (25. 01. 2018).*

The graduates that have practical and relevant STEM regulations set in their educational experiences will be very demanded for in all sectors of work. It is estimated that in the next five years, larger companies in Bosnia and Herzegovina will have to employ STEM-qualified workers. Data on the labor market also show that the set of basic cognitive knowledges, skills and abilities are connected to STEM education, and they are demanded now, not only in traditional STEM profession, but also in almost all sectors of employment and types of jobs (Carnevale, Smith, & Melton, 2011; Rothwell, 2013). Geography strongly connects STEM (IT/ information technologies science, engineering, and mathematics) disciplines using geographic technology/tools that may offer better understanding of interdisciplinary occurrences for solving important problems. Relevant sectors of economy based on knowledge in Bosnia and Herzegovina.

1. Information – Communication Technologies (ICT),
2. Healthcare and medicine,
3. Technology of materials and high-technological manufacturing,
4. Energy production, energy transfer, efficiency,
5. Business and finance,
6. Art, entertainment and media,
7. Sport,
8. Tourism,
9. Entrepreneurship,
10. Modern agricultural manufacturing.

ORGANIZATION OF A STEM WORKSHOP IN BOSNIA AND HERZEGOVINA

These studies are represented by groups of professors/teachers of geography, biology, mathematics, physics, chemistry and information technologies. The group would be divided into two teams of members who would present disciplines during the workshops along with connectivity with other subjects. Additional group work occurred as the result of experts from the USA, (Joseph Merlion 2007), and the local expert team from Bosnia and Herzegovina. The American experts have also joined and presented themselves and their experience in STEM education in the USA. Insight into the newest studies and discussions on how to improve the STEM education and learning, including how to ensure the engagement and success of students in primary and secondary schools. In 2017, in cooperation with the USAID and Save the Children in Sarajevo, there were 30 experts and leaders invited to STEM for learning in order to learn how to participate in a series of workshops founded on deliberations to understand ideas and develop recommendation for the future of STEM education. (Atkinson, R. D., Hugo, J., Lundgren, D., Shapiro, M. J., & Thomas, J. (2007).

The key components of visions are the result of a series of workshops and discussion held in 2018. They were organized in Sarajevo in the Department for USAID and with Save the Children for education with expert and financial support. Almost 45 individuals from Bosnia and Herzegovina, that represent a wide spectrum of expertise, experience and perspectives, were invited to exchange knowledge and ideas for the possible future of STEM education. We have summarized the results of these discussions, and they contain what has come out as expert recommendations. Namely, it is emphasized that the desire for STEM education, as lifelong education, is present among all youth in all local communities in Bosnia and Herzegovina. Participants in this project were ask to take from their own experience and knowledge, and to apply that to the evidence behind examples of innovative and promising new approaches that are held in local communities across Bosnia and Herzegovina. (Figure 1 and 2)

Figure 1
STEM workshop with other subjects by learning outcomes in Sarajevo, 2018
Source: *Save the Children*

Considering the challenges of remaking STEM education in a large scope, the STEM vision is represented in this study in its starting point upon the key groups of stakeholders, including the policy creators, researchers, educators and leaders of local projects in Bosnia and Herzegovina (Nurković, R., 2012). These activities in workshops offer significant obstacles for entrance and encourage creative ex-

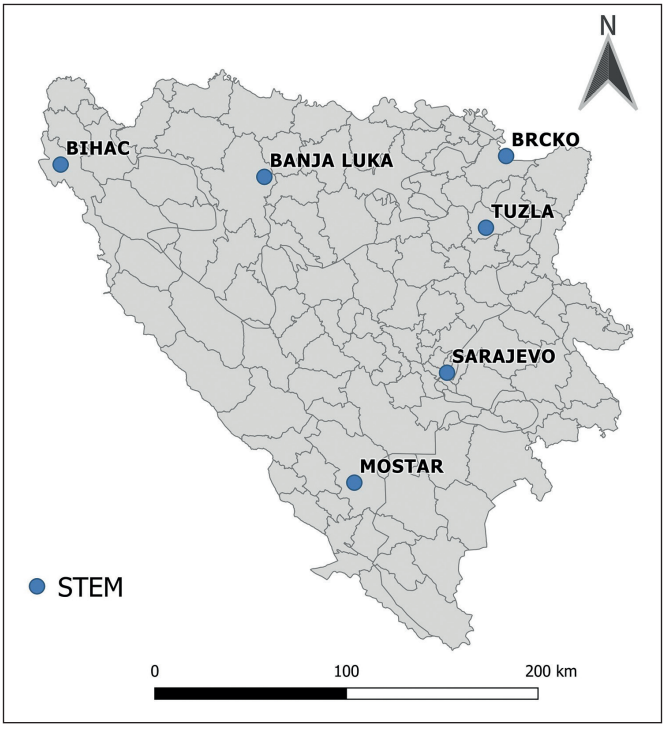

Figure 2
STEM workshop with other subjects by learning outcomes in Sarajevo, 2018.

pression of ideas, and, at the same time, engage various students in complex and challenging contents. Through the process of research and detection, they notice that STEM is all-present, and that they have something to contribute to the field and to learn to use the team approach in solving problems and challenges from the real world. The experts claim this. Those are the types of thinking about growth and habits that show capabilities for academic work and perseverance and lifelong learning in a fast-changing world (Dweck, Walton, & Cohen, 2014; Sharples, 2000). The educational experiences include interdisciplinary approaches in solving „great challenges", and STEM education includes students of all ages in solving great challenges. Great challenges are those that have not yet been solved on a local, national or global level. Great challenges may include, for example, preserving water or improving the quality of water; better understanding of the human brain in order to create new ways to prevent, treat, and treat disabilities and defects of the brain; development of new technologies that enable a better approach to healthcare; solving the infrastructure problems; or, creation of solar energy using costs of the competitive and electric vehicles that are accessible (Chen, J. A., Metcalf, S. J., & Tutwiler, M. S. 2014).

The task of children and youth, faced with a great challenge, is to understand the importance of STEM in their lives and to see the value of STEM in answering questions that improve their own lives and the lives of others. Great challenges also offer a platform for including culturally relevant approaches and contents into the STEM instructions (Dangermond,J. 2013). These portraits include various images, descriptions or images of that which represents STEM work, including a series of tasks and activities that use STEM; and, who they see doing and leading the work in STEM education. Communities and youth in all settlements and geographical locations in Bosnia and Herzegovina are equally exposed to social and popular media that focus on STEM, as well as the wide diversity of toys and games that are accessible and inclusive, and that effectively promote belief of all students that are enabled to understand and shape the world through STEM disciplines. This is when the local experts of STEM expressed their objections in the sense of advantages and weaknesses of students currently studying at universities throughout Bosnia and Herzegovina. The advantages are that students 1) gain a lot of information, 2) have a solid theoretical knowledge,) have a solid practical background, 4) know foreign languages better than previous generations, 5) gain a solid education from mathematics and sciences in school prior to enrolment into a university, 6) do not study only for the purposes of ensuring a career.

The project promises that there will be an evaluation system and quality measurement system through the STEM programme by 2019, which will, at the same time, serve also as a foundation of professional development of each individual teacher. A teaching license will be adopted, and it will be renewable. The main condition for renewing of the license, except the success in the current work in STEM education for primary and secondary schools in Bosnia and Herzegovina, will be participation of individuals in a system of professional improvement and development of geography teachers. The study contents will be unburdened from unnecessary factology and better connected to life and development of science, technics and technology; they will stimulate application of methodology focused on child/student and on development of critical thinking, where students would be able to solve problems and apply their knowledge from the STEM programme upon completion of their primary and secondary education (Demski, J. 2009).

The students would not only be evaluated, they would also evaluate their teachers, where the system of internal evaluation would be in place. They would also perform a self-evaluation, as well as, integral and external evaluations in order to improve the effectiveness of the education process and all-inclusive monitoring of the work of educational institutions and teachers. All that was researched through STEM education is valid for whole Bosnia and Herzegovina, regardless of the curriculum that was in place. However, it was necessary to perform the whole process of education for the teachers of geography, mathematics, physics, chemistry, biology and information technologies, with the support of experts from

the USA through workshops by learning outcomes and subject in smaller groups. The Agency for preschool, primary and secondary education, within the Ministry Council of Bosnia and Herzegovina, will lead and coordinate anticipated education reforms (James, R. K., Lamb, C. E., Householder, D. L., & Bailey, M. A.2000).

CONCLUSIONS

The analysis confirms a high level of interdependence between STEM education and economic activities in sectors of knowledge in Bosnia and Herzegovina. More than 60 % of schools in Bosnia and Herzegovina accepts STEM education. From this, we should recognize geography as STEM education in Bosnia and Herzegovina. Geographical departments in the University of Sarajevo will have benefits from this innovation since they will attract more students interested in STEM education. STEM education, which contains these six basic principles, promises a powerful transformation in the approach towards all students in Bosnia and Herzegovina. Coordinated inclusion and pooling of resources among a series of interested parties, may together offer encouragement of the study and evidence, as well as a possibility and access to a high-quality STEM experiences of learning, which will help to ensure that all children of the nation gain a much needed and deserved education. Surely, the challenges remain, however, lessons may be learned and ideas for progress may be developed based on works of modern innovators and regions, districts, schools, communities, and non-profit organizations that are already creating changes. In this process of unveiling and disseminating knowledge, and through a wide-spread national, regional and local learning networks, they may go back to STEM until 2026 vision presented here, in order to adapt and perfect the STEM future education in order to gain new experiences and new evidence, especially, the knowledge of which approach functions best in which contexts and how it serves various students (Nurković, R. 2014).

In conclusion, the basic STEM 2026 is a vision for an innovative future that enables a process of mapping backwards. It is a process that stimulates action amongst key interest groups and this helps to identify what we already know, what needs to be discovered, and what needs to be developed in order to achieve the final goal – creation of justice in STEM for promotion of lifelong learning amongst youth in Bosnia and Herzegovina. From the student aspect, it is necessary to have motivation (recommendation of the engagement). This has to make sense and to be attractive for them, in order for them to be absorbed in the material. In other words, it is synchronized exercising when they lose desire and will for learning. The surprise, discovery and curiosity should be some of the leading principles in teaching children to learn. The focus is on the „know", „understand" and „use". Completing each lesson with a situation and leading students through later experience is one of the ways of teaching. The idea is that the curriculum is surely covered; the

question that remains is the question of methodology which is used in order to motivate students to learn. This contributes to the economy based on knowledge, where the general aim of the project is still leaning on 10 already defined competencies and predisposed education system. It is considered to be a very general approach, when we assess the real situation in our school. The remaining challenge is how to adapt the curricula according to this general goal (Desimone, L. M. 2009).

What we may offer is a pragmatic approach to the implementation of the existing educational structure. One opinion is that the „learning to learn" could be the most important educational field that may be used as the main topic, and the second opinion is that we must use something „more attractive" for children to desire to go to school. It is necessary to include APOSO in this starting phase in one meeting, in order for them to understand the whole process. Generally speaking, we should bring STEM in touch with the implementation of the existing curricula – one or two projects per semester, and those are of integrative nature (even including the wider communities, creating internships – there are a whole series of opportunities). The focus is on how we teach (for children to understand the logic behind it), and not what we teach – how to help children to achieve the learning objectives. Mr. Merlino will update the team of experts with these new findings during this pre-planning meeting in Sarajevo. In the meantime, local expert team in Bosnia and Herzegovina will have enough time to meet, think about and process all this new information. Also, discussions and dialogue between American and local experts (in groups) are planned. Soon, we will decide on exact time, dynamics, preparation, time frame, homework, etc. The purpose is not have a rigid agenda at this time, in order for us to be able to adapt to our needs in the near future. The meeting with the expanded STEM working groups was held from 14th to 16th of June of 2017 (2.5 days). The American STEM experts (3 persons in total) arrived on 13th of June, 2017, when the first STEM meeting with local STEM experts regarding all questions at the time and the anticipated questions (besides the Skype meeting that was held prior to 13th of June, 2017).

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ABBREVIATIONS

BH - Bosnia and Herzegovina
EU - European Union
FBiH - Federation of Bosnia and Herzegovina
FDI - foreign direct investment
IMF - International Monetary Fund
KM - Convertible mark
RS - Republic of Serbian
STEM - Science, Technology, Engineering and Mathematics
UNCTAD - United Nations Conference on Trade and Development
USA - United States
USAID - United States Agency for International Development
WTO - World Trade Organisation