STE(A)M EDUCATION CHALLENGES IN BULGARIA

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Abstract: Technological progress has led to the development and implementation of innovative approaches, methods and practices in our educational system. One direction of this trend is STE(A)M education. After the global advent of STE(A)M learning, the education system in Bulgaria faces certain challenges: creating suitable STE(A)M environment, teacher-training and preparation for approach implementation, student and pupil instruction using modern educational approaches, STE(A)M in particular, development and approbation of good pedagogical practices.

This article presents the results of a research encompassing Bulgarian publications in the field of STE(A)M in the last four years. The aim is to find answers to the question: "What is the direction Bulgaria has assumed to work towards overcoming the obstacles and challenges?" The research method used in the article is *analysis* of published articles from Bulgarian authors, regarding STE(A)M education in Bulgaria.

The research was carried out from the end of 2022 to the beginning of 2023. It encompasses fifty articles published between 2018 and 2022 in various e-media and conventional paper issues. Derivation of key words such as "STEM education", "STEM learning", "STEM essence", as "STEAM education", "STEAM learning", "STEM approach" and "STEAM approach" were used to find the articles. After thorough analysis, it was confirmed that 38% of all Bulgarian articles investigate the essence of STEM/STEAM education.

The results of a survey amongst teachers, administrators and university students is also presented in the article. The aim is to shed light on the current attitude of working and future pedagogical experts towards STE(A)M education. The teacher and student survey was conducted during the previous three school years (2020-2021, 2021-2022, 2022-2023). The interval of the survey was after the start of the national programme "Development of School STEM Environment" of the Ministry of Education and Science. There are certain differences between the opinions of the students, due to the fact that the majority have learnt the most about STE(A)M through social networks, and the rest have been taught a compulsory university subject – STEAM-based training in Informatics and Information Technologies. The percentage of teachers acquainted with the essence of STE(A)M education is significantly lower, and the implementation of the STE(A)M approach in Bulgarian education is a rather slow process.

Keywords: STE(A)M education in Bulgaria, STE(A)M approach, teachers, students, STEM centres

1. INTRODUCTION

The STE(A)M approach has prevailed globally in the field of education for the last two decades. It is due to the fact that while using it the student is the focus of training and interdisciplinary and transdisciplinary lessons are part of the process. Training changes focus from theoretical concepts to practical activities aiming at improving the competences and developing the skills of the students. This has imposed several challenges to Bulgarian education: creating suitable STE(A)M environment, teacher-training and preparation for approach implementation, student and pupil instruction using modern educational approaches, STE(A)M in particular. Facing the first challenge, the national programme "Development of School STEM Environment" of the Ministry of Education and Science, which "aims at creating school STEM centres and focuses on studying and applying competences in the field of mathematics and sciences in Bulgarian state and municipal schools", started in 2020 (MON, 2020). After the initial physical creation of STEM centres in Bulgaria, the teachers faced the challenge of implementing STE(A)M lessons and activities. This led to the necessity of improving the competences of university instructors and clarification of the theoretical concepts regarding STEAM approach and its implementation. The final stage was to prepare and carry out training courses on STE(A)M education.

The aim of the review is to perform a literary analysis regarding STE(A)M education in Bulgaria in two directions – essence of the approach and opinion of teachers and students of its applicability in education. The search of relevant scientific articles was done using https://scholar.google.com/, it also includes articles published in Bulgarian STEM magazines and anthologies. Derivation of key words such as "STEM education", "STEM learning", "STEM essence", as "STEAM education", "STEAM learning", "STEM approach" and "STEAM approach" were used to find the articles. The articles had to meet the condition to be written by Bulgarian authors - university lecturers and teachers. After review and analysis, 50 STEM and STEAM education related articles by Bulgarian authors were chosen.

2. ESSENCE OF STE(A)M EDUCATION

The acronym STEAM stands for Science, Technology, Engineering, Arts and Mathematics. The scientific fields involved in STE(A)M are rather wide-ranging and constantly evolving, that is why there is not unity regarding the terminology of STE(A)M's essence. The most frequently used terms globally in STE(A)M's definition are "integrated", "interdisciplinary" and "approach". STE(A)M is defined as interdisciplinary or transdisciplinary approach, which integrates separate disciplines (Science, Technology, Engineering, Arts and Mathematics) in a complex unity. The approach is founded on project based learning, solving real life problems in order for the students to gain personal experience, teamwork and developing 21 century skills.

After analysis of articles from Bulgarian authors, it is noted that 19 of them in total regard the essence of STEM/STEAM education. The review shows a very small part of the authors examine the theoretical concept of the emergence and development of STEM/STEAM education (Kozhuharova & Zhelyazkova, 2021) (Garov & Peykova , 2019, 11.07-08), (Kotseva, 2021. 06.04-06)). Other mentioned briefly STEM education's essence ((Atanasova & Todorova, 2021), (Papancheva & Dermendzhieva, 2021), (Gospodinova, 2022), (Papancheva & Dermendzhieva, 2020), (Kotruleva, Sh., 2020)).

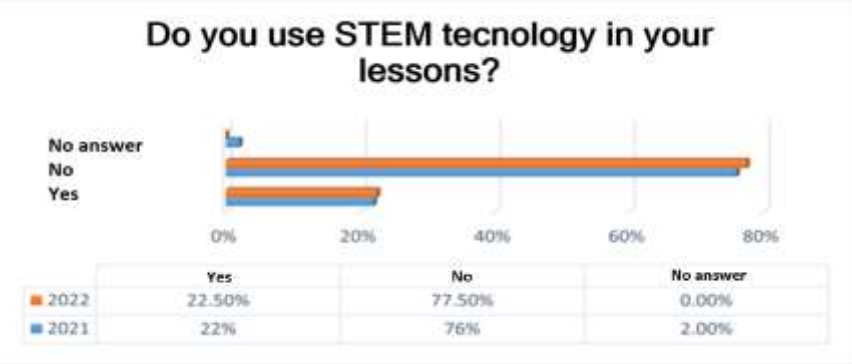
It seems that there is not a unanimous theory regarding the essence of STE(A)M education amongst Bulgarian scientific communities either. STEM or STEAM is regarded as an educational approach in 32% of the articles. Unlike them (Zheleva, P, 2021) and (Topalska, R., 2021a) describe STEM/STEAM as a method, which provokes cognitive activity. Kuranova (2022), describes STEM as a curriculum (Kuranova, K., 2022). 78% of the articles described a good pedagogical practice or resources that can be used in STEM/STEAM education, while part of them examine the essence of STEM/STEAM in the course of several sentences, as pointed previously in the article. This situation could be explained by the fact that a lot of good practices were implemented before the initial analysis of theoretical formulations and reaching unanimity amongst scientific communities in regards to STE(A)M education.

3. STE(A)M EDUCATION – OPINION OF TEACHERS AND UNIVERSITY STUDENTS

Having in mind the fast advent of STE(A)M education in Bulgarian schools and the prevalence of publications related to good practices, the author was intrigued to analyze the articles which examine the second challenge – STEM approach implementation teacher training and the opinion of teachers regarding current changes in education. Only 6 of the articles analyze teacher survey results. Kozhuharova, D., M. Zhelyazkova (2021) share analysis of a survey among 156 Bulgarian teachers in different subjects and grades to collect information about their attitude and knowledge about the essence of STEM education as well as the applicability in Bulgarian schools. The demographic representation in the survey corresponds very closely to the overall distribution of teachers in Bulgaria as follows: ages 40 to 50 (35.3%); over 50 (35.3%); under 30 (3 .9 %) and 32.7% teach in primary level 23.7% in junior high school level and only 1.3% university teachers. The analyzed data shows that 27.5% are familiar with STEM in its essence and 29.7% are acquainted with the terminology without having deeper knowledge about the approach. When looking at the distribution of correspondents according to the grades they teach, elementary teachers (51 participants) are the largest group who are familiar with STEM: 29.4% (15 people) were aware of the terminology behind the acronym STEM and 25.5% (13 people) to some extend while 17.7% did not recognize it. Junior high school teachers were represented by 31 participants where as follows: 25.8% of the are aware of what STEM is, 38.7% rather know and 9.7% do not know. In the group of participants teaching in high schools (32 teachers) 25% responded positive to having knowledge about STEM , 25% - somewhat and 12.5% are not familiar at all. Only 22% of the participants responded that they use STEM technologies, while 76% answered negative (2% empty values). The authors conclude, "The slow pace of implementation of STEM education in the Bulgarian school is due to some extent to insufficient knowledge of STEM education and its advantages. A probable problem is the lack of sufficient methodological and practical guidelines for teachers from the various academic disciplines and educational levels to support the implementation of STEM in education." (Kozhuharova, D., Zhelyazkova, M., 2021) Although the results in that aspect might be discouraging, it is interesting to point out that 86% from the participants in the same research answer positive to the question if they think STEM implementation has its place in Bulgarian education.(Kozhuharova, D., Zhelyazkova, M., 2021)

In 2022, the research was repeated again this time among 200 teachers (Zhelyazkova, M., 2022) with participants in the same age distribution groups as follows: age 40 to 50 (46%), above 50 (27%), with the smallest group of under 30 (4%). The largest group of teachers was from elementary schools (26%), 25% in kindergarten, and the smallest group from the university lecturers (1%). The analysis shows that there is a slight increase of .05% among the teachers, who use STEM in their lessons (fig.1). As the author notes, "from the data provided we can conclude that STEM approach implementation is slow, regardless of the development of STEM centers in the schools." (Zhelyazkova, M., 2022) There is an increase of 3.1% in the group of teachers, who agree that STEM approach is appropriate for Buglarian schools. (Zhelyazkova, M., 2022)

Fig. 1. Comparison of survey data from 2021 and 2022.



These results could be owed to some extent to the insufficient amount of scientific literature in Bulgarian regarding the essence of the STE(A)M approach, the methods and the means of its implementation, its advantages and disadvantages. Furthermore, another explanation is the lack of methodical guidelines for STE(A)M approach implementation in different levels and school subjects. In the future, all aspects of STE(A)M education are yet to be examined in detail by the scientific communities in Bulgaria and a unanimity regarding terminology is expected at some point. It is worth noting that unlike the before mentioned authors, associate professor V. Uzunova (2022) present in their article results from survey of teachers who utilize STEM approach in their work. However, it focuses on the types of social and emotional skills are developed by students and teachers while using STEM approach. Topalska, R (2021) pays particular attentions to the opinion of school principals, who participated in the national programme "Development of School STEM Environment", regarding the pedagogical and technological challenges and opportunities accompanying the creation of STEM/STEAM centre. (Topalska, R., 2021b)

Of all the analyzed articles, only two mention the third challenge – teaching pupils and university students using modern approaches, STE(A)M in particular. They focus on the opinion of university students – the authors of the articles are Topalska, R. (2021) and Kozhuharova, D. (2022), who research students' opinion in regards to STE(A)M education. STE(A)M training in the assessment of students - future teachers, presents the results of a survey conducted in the academic year 2020/2021 with 107 students (Faculty of Pedagogy , Southwest University "Neofit Rilski", Blagoevgrad) - future educators, dedicated to STE(A)M training. From the results it is understood that 51% of the students are familiar with the concept of STE(A)M, it is worth noting that the most of them learnt about it from social networks. What is more, 15% of the students "do not think they need further training and qualifications, devoted to the implementation of this interdisciplinary method" (Topalska, R., 2021a), the positive aspect is that the majority of students feel that they need further preparation. Additionally, 70% answer rather positively to the question "Do you think you will be successful in utilizing STE(A)M methods?" (Topalska, R., 2021a). Unlike Topalska, Kozhuharova, D. (2022) presents results from a survey among university students attending "Pedagogy of Information Technology Education" programme at the Pedagogical Faculty at Thracian University, after the compulsory discipline "STEAM-based education in Informatics and Information Technologies". To the question "Is implementation of STEAM learning suitable for Bulgarian education?" 92% responded positively and only 8% (1 student) responded negatively. (Kozhuharova, D., 2022).

In order to face the aforementioned challenges it is necessary to implement STE(A)M learning in tertiary education, with a view to achieving better preparation of future teachers and the consequent implementation of the approach in Bulgarian schools. We can see two faces extremes in the articles – on the one hand students that have gained knowledge of STE(A)M through social networks and on the other hand – students, who have actively studied the subject at university.

4. CONCLUSION

After the thorough analysis of the articles, it can be concluded that Bulgarian authors focus on the presentation of good practices regarding STE(A)M education. The theoretical analysis of the approach has not been exhausted to its full extent and is yet to be completed along with the examination of STE(A)M components and its advantages to education. The majority of the authors combine the presentation of theoretical concepts along with utilization of resources or accomplished lessons. Having the analysis of the teacher/student surveys we can conclude that both groups believe that STE(A)M education is suitable for implementation in Bulgarian schools. Last but not least, there is an urgent need for change in terms of tertiary education so as to provide better instruction and training to future

and current teachers regarding the STE(A)M approach. Only by doing so will our education system be ready to face the challenges accompanying its implementation.

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