DOI: 10.46793/STREAM25.023F
UDC: 37.013:001.1

# THEORETICAL FOUNDATIONS IN INNOVATING SCIENCE TEACHING USING STEAM EDUCATION

Aleksandra N. Filipović*
*International school "Crnjanski", Jagodina, Serbia*

Dušan P. Ristanović
*Faculty of Education, University of Kragujevac, Jagodina, Serbia*

Olivera D. Cekić Jovanović
*Faculty of Education, University of Kragujevac, Jagodina, Serbia*

*Abstract:* The paper explains the key theoretical and methodological assumptions of innovating and improving the quality of teaching science using STEAM education. Using the theoretical analysis, it was established that STEAM education is based on a cognitive process aimed at solving problems from the real world, project learning, cooperative learning, research teaching, and the application of procedures that encourage students to be productive, self-initiative, and reflective. The roles of students and teachers are founded on cooperation. The focus shifts to students who assume the role of researchers, creators, leaders, and evaluators; teachers take the role of facilitators in the teaching process. The application of STEAM has certain limitations. Primarily, teaching staff has insufficient capacities to conceive, design, implement, and evaluate teaching concerning STEAM. Moreover, the model structure in which the standards and outcomes of all disciplines included in STEAM would be equally represented is an intricate task. The conclusions indicate that the aspects, advantages, and positive characteristics of STEAM surpass the deficiencies. Hence, STEAM should be applied in teaching science to a greater extent.

*Keywords:* STEAM education, science teaching, content integration, knowledge transfer, active learning

## INTRODUCTION

Narratives about the competencies necessary for life in the 21st century have stimulated numerous discussions about the imperatives of the contemporary educational system. There is a real danger that many of the skills taught to students today will become obsolete, due to rapid changes and advances in various

* afilipovic258@gmail.com

fields, especially technology and industry. In addition, today's students' needs are very different from the needs of those educated just a few decades ago. That is why there is a growing need for education that will be able to create a more dynamic, flexible, and future-relevant learning environment (Belbase et al., 2022). The extent to which the imperatives of modern education, adapted to the acquisition of appropriate skills and functional knowledge, are represented in our educational system in the field of natural sciences, is attested in the findings obtained by analyzing the mistakes made by students of the fourth grade of primary school within the framework of the TIMSS research in 2019 (Stanišić, Blagdanić, & Marušić Jablanović, 2021). The results imply the need to connect knowledge with everyday life and train students to transfer knowledge from different fields. The new education should change the direction "from education intended for the student to education that starts from the student, education in which the student is less and less someone whom they form, shape, from whom they want to create something, and more and more a self-shaped, conscious personality, a subject which changes itself" (Vlahović, 2020: 21).

Science teaching, as part of modern education, represents an important link in the formation of an individual who will be able to use the acquired knowledge to explain how the world around us functions, formulate conclusions and understand the changes in the field of natural and social sciences. For these reasons, students should be trained to be active participants in a teaching process – initiators of activities, researchers who express themselves creatively, and critics and evaluators of their achievements.

## METHODOLOGICAL FRAMEWORK

This paper aims to determine the basic theoretical assumptions behind the STEAM innovation in science teaching. To reach this goal, three research project tasks are set: 1) to determine the characteristics and structure of STEAM education in science teaching; 2) to determine the impact of STEAM education on the changes in student roles with respect to the traditional model of content acquisition in science teaching; 3) to determine the limitations in the STEAM application identified in the previous quantitative and qualitative research on the topic. This descriptive study analyzes the procedures in the theoretical and empirical scientific articles dealing with STEAM education.

## RESULTS AND DISCUSSION

The following section provides an overview of the findings according to the previously defined research tasks.

### *STEAM Education: Innovative and Transformative Approach to Learning in Science Teaching*

Contemporary methodical theory and practice strive to integrate several different scientific disciplines to contribute to the overall development of a personality. This is not a novelty if we take into account that Comenius believed that education should be students' preparation for life, whereby students should acquire functional knowledge and skills of reasoning and critical thinking (Komenski, 1997). One of the concepts that have numerous positive effects on the development of competencies for the 21stcenturyis STEAM education (Belbase et al., 2022; Boice et al., 2021; Bush & Cook, 2019; Hoi, 2021; Yakmen, 2008; Li et al., 2022; Wu, Lui, &Huang, 2022).

The term STEAM is an acronym that unites the fields of science, technology, engineering, art, and mathematics in an integrated approach to topics related to everyday life situations. Georgette Yakman is believed to be a creator of this concept since he integrated arts into the existing STEM concept, emphasizing that arts enable a more comprehensive approach to learning. Yakman (2008: 17) presents the STEAM schematically as a pyramid (*Figure 1*). The foundation of STEAM education comprises a wide range of scientific disciplines within the five main areas. Hence, the approach to learning is not interdisciplinary but rather transdisciplinary. This is symbolically presented as *STΣ@M*, where the mathematical symbol Σ (sigma) stands for the sum of all values, and it is used here to emphasize the holistic character of STEAM.

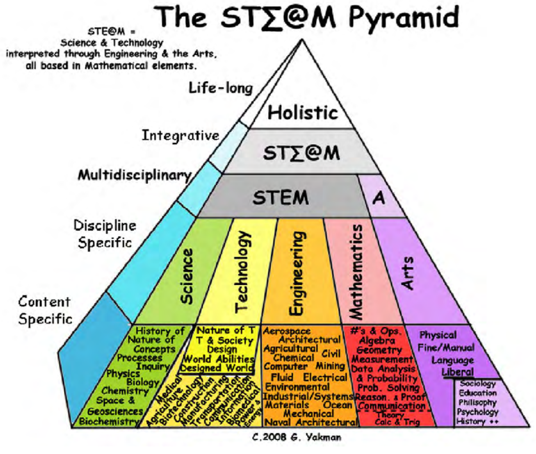


*Figure 1: STEAM pyramid (Yakman, 2008:17)*

By placing the pyramid in the context of the goals and outcomes that are achieved and the content that is studied within science teaching (*Table 1*), we can observe the study areas of the presented scientific disciplines and how they correspond to the basic intention that science teaching should aim to develop all spheres of a student's personality, whereby the boundaries between the studied topics "should be understood conditionally and flexibly" (*Pravilnik*, 2019:43).

*Table 1: The STEAM disciplines in the science lessons for the 4th grade of elementary school*

| SCIENCE TEACHING | | THE REPRESENTATION OF THE STEAM SCIENTIFIC DISCIPLINES |
|---|---|---|
| TOPICS | CONTENTS | |
| **Natural and social characteristics of Serbia** | Position, territory, borders, and symbols of Serbia and its national currency.<br>Natural characteristics of Serbia – relief, water, forests.<br>Typical, rare, and endangered species of plants and animals – importance and protection.<br>National parks of Serbia.<br>Social characteristics of Serbia (population, settlements, and activities).<br>Citizens of Serbia (rights and obligations, democratic relations, and interculturality).<br>Economic characteristics of Serbia (natural resources and activities in different regions).<br>Sustainable use of natural resources | SCIENCE:<br>The representation of the content from the fields of geography, geomorphology, ecology, biology, demography, and sociology<br>TECHNOLOGY:<br>The application of various digital research tools (Google Earth, Google Maps, VR and AR applications)<br>ENGINEERING:<br>The consideration of different ways of environmental protection, rationalization of natural resources, industrial engineering, mining engineering<br>ART:<br>Modeling relief forms, visual presentation of state symbols<br>MATHEMATICS:<br>Fractal presentation of demographic data, mathematical calculations related to the area and population |
| **Man is a natural and spiritual being** | Man – a natural, social, and conscious being.<br>Physical changes in puberty.<br>Digital security and consequences of excessive use of information and communication technologies; inappropriate contents. | SCIENCE:<br>The representation of the content from the fields of biology, anatomy, physiology, medicine, anthropology<br>TECHNOLOGY:<br>Digital security<br>ENGINEERING:<br>Systems engineering, food engineering<br>ART:<br>The culture of living, the art of creation that distinguishes man from other beings |

| | | |
|---|---|---|
| | | MATHEMATICS:<br>Quantitative data on the development of the individual, nutritional value of food |
| **Materials** | Mixture<br>Separation of mixture components<br>Electrification of objects made of different materials.<br>Electrical conductivity –<br>Conductors and insulators.<br>Rational consumption of electricity and proper handling of electrical appliances in the household.<br>Magnetic properties of materials<br>Flammable materials<br>Air – oxygen as a combustion factor.<br>Fire hazard and protection. | SCIENCE:<br>Representation of content from the fields of physics, chemistry, electrical engineering<br>TECHNOLOGY:<br>The use of software and measuring instruments for the study of the above contents<br>ENGINEERING:<br>Metallurgical engineering, food engineering,<br>electronic engineering<br>ART:<br>Analysis of signs and symbols of flammable materials<br>MATHEMATICS:<br>The quantitative data on electricity consumption, interpretation of non-linear texts |
| **Serbia's past** | Life in the distant past<br>The Serbian state during the Nemanjić dynasty's rule– rise and decline<br>Life under Turkish rule<br>The origin and development of the modern Serbian state (First and Second Serbian Uprising – cause and course; leaders of the uprising; culture, way of life).<br>Serbia in modern times | SCIENCE:<br>The representation of the content from the fields of geography, history, demography, ethnology<br>TECHNOLOGY:<br>The use of software and audio-visual traces from the past<br>ENGINEERING:<br>Construction engineering<br>ART:<br>Tangible and intangible goods<br>MATHEMATICS:<br>The interpretation and the creation of timelines |

The successful implementation of such a complex concept in science teaching requires a carefully designed application and the combination of different strategies, procedures, and activities of students and teachers. Given that it is a concept that encourages students to solve complex problem situations so that they can develop personal competencies and qualities (Hoi, 2021; Mehta et al., 2019), some authors advocate for the STEAM approach with an emphasis on project learning. STEAM project-based learning involves students in designing, problem-solving, research, and decision-making. This allows students to work relatively autonomously for a long time and manifest the products of their work through various artifacts – realistic products or presentations (Liao, 2019). The focus of STEAM viewed through the prism of project-based learning is on the complete course of handling a project, that is, on a path (process) that students have to go through to gain new knowledge. That process includes mistakes, modifications, and a complete consideration of a particular problem. Similarly, there are authors who give priority to the application of research teaching, that is, the so-called *5E* model (*Engage*, *Exploration*, *Explanation*, *Elaboration*, *Evaluation*) within which students are in a position to ask questions, observe, predict, experiment, explain, research, apply knowledge, and verify their assumptions (Stroud & Baines, 2019).

When it comes to citing cooperative learning as one of the main STEAM strategies of education, the authors agree that when students are encouraged to cooperate and critically observe the different views on the same problem, we foster divergent thinking (Boice et al., 2021; Liao, 2019; Li et al., 2022). In addition to cooperative learning, the strategy of cooperative teaching has been also emphasized. As stated before, STEAM supports learning based on students' research work, and problem and/or project model. The very concept can be a challenge for teachers as well. They are required to take the role of facilitators who should teach students about topics that are not directly related to their formal education. In this sense, the cooperation between teachers and subject teachers should be established. This would be an excellent preparation for the subject teaching in the fourth grade of elementary school. Some authors recognize the importance of establishing cooperation with experts from different fields. This contributes even more to the pedagogical values of STEAM education. The application of digital technologies easily solves the problems of physical distance and provides opportunities for organizing visits in a virtual environment (Mehta et al., 2019).

In the literature aiming to explore the characteristics of STEAM education, there is an emphasis on the application of the Design Thinking method, which simultaneously encourages the development of analytical and divergent thinking in students through creative problem-solving (Liao, 2019; Henriksen, Mehta, & Mehta, 2019). The recommended stages in the method application are similar to the stages of the problem model and research teaching with minimal terminological differences. In the first stage, students examine the current state of the phenomenon being studied; followed by defining the problem, considering ideas, creating a prototype solution, and testing the proposed solution model (Henriksen, Mehta, & Mehta, 2019).

Other authors also attach importance to reflections (Bassachs et al., 2020; Wannapiroon, Petsangsri, 2020), emphasizing that reflective learning is closely related to STEAM education. Through reflection, students can develop and acquire competencies that will help them identify correlations between different scientific domains since reflection, inter alia, aims to examine, frame, and contextualize scientific questions to address the hypotheses during experimentation (Bassachs et al., 2020).

However, despite the frequent use of the mentioned keywords that determine STEAM (*Figure 2*), unanimously accepted instructions on structuring STEAM teaching practice do not exist. Ideas vary depending on the goals one wants to achieve, the nature of the integration of disciplines, and the role of art. There are guidelines regarding the insistence on students' practical work, cooperation, research work, and discussion, which is, on the one hand, a mitigating circumstance, because it leaves teachers with the opportunity to maximally adapt the teaching to the prior knowledge of their students and specific working conditions.

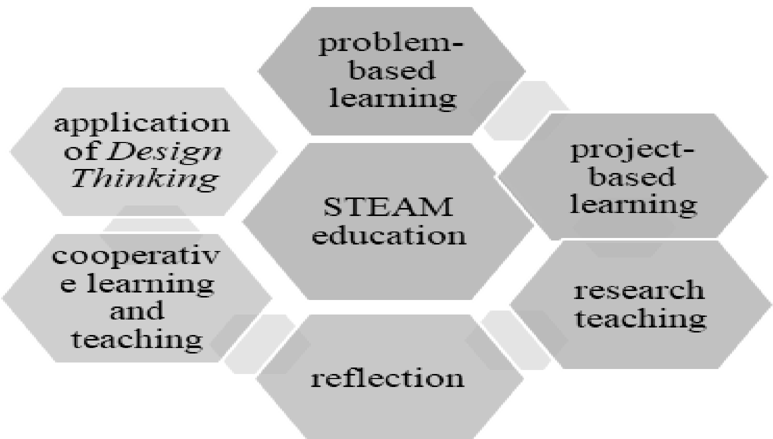


*Figure 2. Recommended teaching procedures and activities in STEAM education*

Depending on the level, the options for STEAM integration can be ordered as follows: the application at the level of individual tasks within partial lessons, the application of learning strategies, and the integration into the complete existing curriculum that can be reformed (Belbase et al., 2022). Based on the above-mentioned analysis of the compatibility of the contents within the science subject program with the areas of study included in STEAM (*Table 1*), we can point out that in this particular case, the integration is possible at the first two levels, i.e. in individual lessons. The last level of integration would require additional involvement and investigations of the expanded context, although there are theoretical foundations for it.

### *Students' roles in science teaching with STEAM*

Based on a holistic approach, STEAM contributes to the expression of students' motivation and positive attitudes toward taking part in classes; hence, it reflects not only on their cognitive, but also on their psychomotor development (Wu, Lui, & Huang, 2022). By setting the characteristic STEAM requirements related to the application, analysis, creation, and evaluation of different conceptual solutions, students strive to reach higher levels of Bloom's taxonomy. This transforms their role as passive participants in the teaching process. Students assume the role of the agents in the investigation of a phenomenon, which changes the center of the teaching process. By providing additional information, encouraging, motivating discussion, coordinating, and monitoring the behavior and progress of students, the role of the teacher during the implementation changes to a different form compared to traditionally organized teaching, where the emphasis is on the activities of a teacher. Teachers become facilitators tasked with providing guidance and additional support, not offering ready-made knowledge and solutions.

By solving real-life problems through STEAM, students are encouraged to "blur the boundaries" between subjects. They focus on the transfer of knowledge from different fields that contribute to a comprehensive understanding of the problem while students are maximally engaged in solving it. Students are allowed to express their doubts, present their observations with arguments, and confront different opinions and attitudes in a polite narrative. Bearing in mind that the complexity of the problems the students deal with can vary, students are encouraged to be productive, persistent, self-initiative, flexible in accepting different points of view, and independent. All these qualities are very important for the skills of the 21st century.

As creators and researchers in STEAM, students strengthen their reading comprehension skills and the ability to adequately select facts by importance while recording their observations in written form. STEAM does not expect the mere memorization and reproduction of ready-made facts presented ex-cathedra; students are stimulated to research independently, draw conclusions, and confirm or challenge formulated assumptions (Belbase et al., 2022). Accordingly, students compare, contrast, and classify the similarities and differences between observed phenomena, connect knowledge of scientific concepts with different properties, present conceptual solutions using numerous visual means (illustrations, graphs, schemes, tables, diagrams, research diaries, photo-narratives), and interpret relevant information based on the independent generalizations previously made. By using technology, students are trained to critically search for the necessary information, observe cause-and-effect relationships, compare the obtained data, and present the obtained work products by citing new examples. According to STEAM, the idea of integrating art into a research process is precisely based on the fact that students are placed in a position to cultivate the ability to visually represent the experiences gained in real-time adequately so that in the following stages of work, they can use their discoveries, documents, sources, and forms of presentation of key data that will lead to new correlations, used for noticing mistakes, making modifications, designing new conceptual solutions, or presenting work results (Stroud & Baines, 2019).

The authors emphasize that students form a learning community in a STEAM classroom that continuously collaborates throughout the year to strengthen group cohesion by fostering individual and collective responsibility, thus encouraging students to work reflectively with peers and in a team (Stroud & Baines, 2019).

Traditional teaching methods differ from STEAM-oriented teaching in that the responsibility for learning is "shifted" to the student and depends fully on his active participation. Students are maximally mentally engaged and progress through their efforts. Of course, this does not necessarily imply that students are left to their own devices. It is about shifting the emphasis from their passive role in receiving knowledge to the role of collaborators in teaching. Depending on the needs of students and research goals, it is possible to negotiate the levels of responsibility placed on students and their teachers (Stroud & Baines, 2019). The changed status of students in the process of such designed teaching requires that both parties understand and respect partnership and cooperation, with clearly defined tasks, rights, and obligations.

### *STEAM application limitations in science teaching*

Despite numerous advantages observed in the application of STEAM education, the authors agree that limiting factors cause incomplete realization of positive effects.

As the primary limiting factor, the authors cite the lack of experts who would deal with the design of teaching content according to the STEAM concept. In practice, there are widespread positive attitudes towards this type of work organization among teachers. However, there is a discrepancy between what teachers believe and how they implement it. Hence, Belbase et al. (2022) raise the issue of motivation and teachers' ability to apply this concept. Among teachers, there is often a fear of teaching a subject that is outside the scope of their formal education. Considering that there is still no consistent structure (model, template, copy) according to which STEAM teaching is conducted, there are teachers who feel this is a barrier to designing lessons, writing preparations, teaching organization, and its implementation (Boice et al., 2021). In Serbia, some recognize the importance of applying the concept, but who believe they need additional support: more literature in the Serbian language and the exchange of examples of good practice via various professional gatherings, forums, and conferences (Filipović, 2022).

An additional limitation is the evaluation of student achievements in STEAM classrooms. As STEAM combines several different disciplines, it is difficult to assess achievements based on the standards and outcomes set for each specific subject. Belbase et al. (2022) suggest student-centered assessment. Their participation in the joint assessments of tasks or projects through peer assessments and self-assessments is enhanced, concurrently enhancing the development of their reflection.  An emphasis can also be placed on the connection of content, engagement, creativity, and originality through keeping a research journal and such evaluations can be diagnostic, formative, and summative. Some ideas promote a holistic approach to assessment and an approach based on success criteria. The difference in these approaches is reflected in the presence of already defined evaluation criteria. Holistic evaluation does not use a set of criteria for evaluating student performance. An evaluator observes the entire object, action, or process. It mainly depends on the holistic effect of the artwork or design and identifying the key features within such an object of assessment without using predetermined criteria. On the other hand, criteria-based assessment uses an established set of criteria with a systematic or predetermined formal structure (such as a rubric or assessment key) to be used during the assessment (Belbase et al., 2020).

The greatest degree of concern and conflicting opinions revolve around the number of disciplines covered by STEAM. While some advocate for the presence of art in its various forms, considering it a segment that contributes to the development of students' creativity, others, on the other hand, point out that by adding more disciplines, the intensity of the content is lost, and each discipline is approached superficially. In addition, many mathematicians believe that mathematics has been put on the back burner due to the dominance of science or engineering; its role in project/problem-based learning has been reduced to the function of a "tool" while its importance for the development of mathematical reasoning and thinking is neglected (Belbase et al., 2020).

## CONCLUSION

The tendencies of modern education imply the need to design an educational system that will meet today's needs by developing 21st-century skills that will prepare students for future occupations and form them as self-directed and self-initiated individuals. For these purposes, it is necessary to encourage students to use knowledge functionally and to accustom them to be active participants in the teaching process: to collaborate, compare, classify, research, assume, try, verify, and evaluate to solve problems from the real world. It is necessary to encourage the transfer of knowledge by eliminating the barriers between subjects. When it comes to students' ability to use the acquired knowledge functionally in the field of natural sciences, there is a need to design a high-quality interdisciplinary approach to the contents of science lessons that will support students in the process of developing their cognitive, affective, and psychomotor domains.

The possibilities of applying STEAM to innovate science teaching are determined, first of all, by the theoretical-methodological framework and the results of adequate empirical research by foreign authors. The analysis of relevant scientific publications on the characteristics and effects of STEAM leads to a conclusion that there is a corresponding innovative potential, viewed through three essential aspects:

1) the need to change the traditionally organized science teaching with modern, transformative, and transdisciplinary STEAM since this approach interprets the nature and function of teaching differently and implies an essential connection of teaching with life, uniting knowledge and skills of five different areas (science, technology, engineering, art, and mathematics);

2) the transformation of the roles of students and teachers in a teaching process, whereby students are partner-oriented to the teacher in that they acquire the status of active participants who have the roles of researchers, creators, leaders, and evaluators; the focus of teachers' work shifts from ex-cathedra lectures to the role of coordinators, mentors, collaborators– facilitators who do not provide ready-made knowledge, but rather motivate students to reach the highest levels of Bloom's taxonomy independently; and

3) overcoming the limitations for the implementation of STEAM including insufficient motivation and training for planning, designing, implementing content, and evaluating student achievements in the fields integrated into STEAM. A high-quality structure design is needed since the standards and outcomes for all disciplines should be equally represented to eliminate the possibility of insufficient and incomplete study of any discipline.

## REFERENCES

Bassachs, M., Cañabate, D., Nogué, L., Serra, T., Bubnys, R., & Colomer, J. (2020). Fostering Critical Reflection in Primary Education through STEAM Approaches. *Education Science*, 10: 384. Available at: https://doi.org/10.3390/educsci10120384

Boice, K., Jackson, J., Alemdar, M., Rao, A., Grossman, S., & Usselman, M. (2021). Supporting Teachers on Their STEAM Journey: A Collaborative STEAM Teacher Training Program. *Education Science*, 11(3), 105. https://doi.org/10.3390/educsci11030105

Bush, S. & Cook, K. (2019). Structuring STEAM Inquiries: Lessons Learned from Practice. In: Khine, M. S. & Areepattamannil, S. (eds.), *STEAM Education - Theory and Practice*, Cham: Springer: 19–36.

Belbase, S., Mainali, B., Kasemsukpipat, W., Tairab, H., Gochoo, M., & Jarrah, A. (2022). At the dawn of science, technology, engineering, arts, and mathematics (STEAM) education: prospects, priorities, processes, and problems. *International Journal of Mathematical Education in Science and Technology*, 53/11, 2919–2955. Available at: https://doi.org/10.1080/0020739X.2021.1922943

Filipović, A. (2022). Gardner's theory of multiple intelligences through STEAM education. In: Marinković, L. (ed.), *Proceedings of Cooperation in order to support the gifted*, Belgrade: Mensa Serbia: 53–62.

Henriksen, D., Mehta, R., & Mehta, S. (2019). Design Thinking Gives STEAM to Teaching: A Framework That Breaks Disciplinary Boundaries. In: Khine, M. S. & Areepattamannil, S. (eds.), *STEAM Education - Theory and Practice*, Cham: Springer: 57–78.

Hoi, H. T. (2021). Applying STEAM Teaching Method to Primary Schools to Improve the Quality of Teaching and Learning for Children. *International Journal of Early Childhood Special Education (INT-JECSE)*, 13(2), 105–1055.

Li, J., Luo, H., Zhao, L., Zhu, M., Ma, L., & Liao, X. (2022). Promoting STEAM Education in Primary School through Cooperative Teaching: A Design-Based Research Study. *Sustainability*, 14, 10333. Available at: https://www.mdpi.com/2071-1050/14/16/10333

Liao, C. (2019). Creating a STEAM Map: A Content Analysis of Visual Art Practices in STEAM Education. In: Khine, M. S. & Areepattamannil, S. (eds.), *STEAM Education - Theory and Practice*, Cham: Springer: 37–56.

Mehta, R., Keenan, S., Henriksen, D., & Mishra, P. (2019). Developing Rhetoric of Aesthetics: The (Often) Forgotten Link between and STEM, In: Khine, M. S. & Areepattamannil, S. (eds.), *STEAM Education - Theory and Practice*, Cham: Springer: 117–142.

Pravilnik o programu nastave i učenja za IV razred osnovnog obrazovanja i vaspitanja. (2019). *Službeni glasnik RS – Prosvetni glasnik*, br. 11/2019.

Stanišić, J., Blagdanić, S., & Marušić Jablanović, M. (2021). Student errors in solving TIMSS 2019 tasks – the field of biology. In: Đerić, I., Gutvajn, N., Jošić S., & Ševa, N. (eds.), *TIMSS 2019 in Serbia: results of an international survey of the achievements of fourth-grade elementary school students in mathematics and natural sciences*, Belgrade: Institute for Pedagogical Research: 193–219.

Stroud, A., & Baines, L. (2019). Inquiry, Investigative Processes, Art, and Writing in STEAM. In: Khine, M. S. & Areepattamannil, S. (eds.), *STEAM Education - Theory and Practice*, Cham: Springer: 1–18.

Vlahović, B. (2020). *Putevi inovacija u obrazovanju*, Beograd: Eduka, Srpska akademija obrazovanja (Vlahović, B. (2020). *Paths of innovation in education*, Belgrade: Eduкa, Serbian Academy of Education).

Wannapiroon, N., & Petsangsri, S. (2020). Effects of STEAMification Model in Flipped Classroom Learning Environment on Creative Thinking and Creative Innovation. *TEM Journal*, 9(4), 1647– 1655. Available at: https://doi .org/10.18421/TEM94-42

Wu, C. H., Liu, C. H., & Huang, Y. M. (2022). The exploration of continuous learning intention in STEAM education through attitude, motivation, and cognitive load. *IJ STEM Ed*, 9, 35. Available at: https://doi.org/10.1186/s40594-022-00346-y

Yakman, G. (2008). *STEAM Education: an overview of creating a model of integrative education*. Available at:
https://www.researchgate.net/publication/327351326_STEAM_Education_an_overview_of_creating_a_model_of_integrative_education