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SELF-ASSESSMENT OF THE COMPETENCIES OF EMPLOYEES IN EDUCATIONAL INSTITUTIONS FOR THE STEAM CONCEPT OF EDUCATION

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Abstract: Unlike the conventional one, the STEAM concept integrates knowledge from several fields to solve problems and "big questions," respecting the individuality of children and the collaborative way of working. In addition to acquiring knowledge, this approach also plays an important role in developing key competencies for lifelong learning, which recommends its integration into educational work from the earliest age. Given that the research shows insufficient representation of the STEAM concept in educational systems, despite its advantages, the question arises of the competence of employees in educational institutions for the STEAM approach. In this sense, the aim of the work is to determine the competencies for the STEAM approach of the employees in preschool institutions and elementary schools. The research was carried out in the preschool institution Veselo detinjstvo and the elementary schools Raška and Sutjeska in Raška, among nursery school teachers, teachers from the first to the fourth grade, and specialized teachers from the fifth to the eighth grade, within the framework of focus groups, and based on an interview protocol that contains key determinants of the STEAM approaches and key competence for lifelong learning. The self-assessment of competences and the researchers' direct insight into their answers revealed a lack of competencies, with an evident difference between the mentioned groups. Namely, it is concluded that nursery-school teachers are the most competent group, followed by specialized teachers, while teachers from the first to the fourth grade have the least competence. The aforementioned finding can be interpreted through the prism of initial education and the (un)representation of these contents in study programs, as well as professional development, judging by the fact that the largest number of nursery-school teachers attended trainings for a project-based approach to learning, that the training in the function of STEAM learning was organized for subject teaching, in contrast to class teaching, in which subject fragmentation is the most dominant.

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Pedagogical implications are contained in the recommendations for professional development, which are reviewed through the results of the research.

Keywords: STEAM concept, self-assessment of the competencies, project approach to learning.

INTRODUCTION

The determinants of social changes are more and more numerous and visible. At the same time, they determinate the education system as well, especially when it comes to changing the learning paradigm that should meet the needs of the knowledge society (Bralić, 2016) and developing key competencies for lifelong learning (Eurydice, 2012). In the function of empowering individuals to face the demands of the knowledge society, the educational policy must meet the improvement of the quality of teaching programs and their implementation. In order to develop a holistic personality, in a personal and professional sense, reflections are imposed on which knowledge should be adopted to develop the practical abilities of individuals for successful functioning in the challenges of modern society. It is necessary to create a curriculum that goes beyond the framework of the traditional subject knowledge and insists to a greater extent on the greater participation of students and the integration of knowledge, skills, and attitudes that will be applicable in different life contexts. Furthermore, more importance should be given to the learning process than to the result itself in the form of knowledge that is checked via tests. This implies the need for a research approach in teaching and the strategy of its organization in the function of more effective development of children's competencies and social benefit. In order to achieve this, it was necessary to replace the traditional approach to education, which was dominated by the acquisition of ready-made knowledge, with an approach dominated by the co-construction of knowledge, by integrating content from different fields.

THEORETICAL APPROACH TO THE PROBLEM

An approach to teaching and learning that integrates science, technology, engineering, arts, and mathematics, and within which there are learning methods that include problem-solving, i.e. questions, discussion, critical thinking, and reasoning, is called STEAM education (Breiner, et al., 2012). Initially, this approach did not include arts as an integral part, so it was labeled as STEM. Over time, the benefits gained from arts have been spotted, so that this approach has been enriched with the art contents. Although the results of the research confirmed the benefits of the mentioned approach to learning, primarily because

they encourage the "4Cs": communication, critical thinking, collaboration, and creativity (Scott, 2015), there are, however, significant difficulties contained in the question: How to create modern STEAM programs that support the development of skills for the 21st century and implement them in the class-subject-hour system? On the other hand, there is a question: how to create a curriculum that includes the mentioned areas and in what way to realize them, given that the subject content is studied at school in a time unit of 45 minutes? The difficulties can be overcome if there is a motivation of teachers for joint work, as well as the design and realization of project activities with integrated content from different sciences, technology, engineering, arts, and mathematics. A project approach to learning contributes more effectively to the development of key competencies for lifelong learning, which, in addition to subject-related competencies, also include cross-curricular competencies (Popović & Ristanović, 2020; Popović & Beara, 2022). Therefore, although the focus of the STEAM concept is the acquisition of knowledge from various fields and their practical application in the function of overall social development, a great contribution is also made in the development of some other life-practical competencies, such as: communication in the native and foreign languages, cooperation, teamwork, digital competence, entrepreneurship and entrepreneurial competence, proper attitude towards health and the environment, aesthetic competence, problem-solving, creativity, and responsible participation in a democratic society (General achievement standards for the end of general secondary education and upbringing and secondary professional education and upbringing in the part of general education subjects, 2013). In this way, children's curiosity for learning content from various sciences is developed from an early age through play-like activities, and it is understood that the aforementioned competencies also provide greater chances for employment (Soylu, 2016). Some researchers emphasize that STEAM education provides the opportunity for students from an early age to ask questions, observe, investigate, predict and search for solutions, like scientists and they are directed toward research work in the future (Ceylan & Akçay Malçok, 2020).

Due to the stated reasons and needs, the teacher's role becomes more complicated, especially the importance of their competence for cooperation with other teachers, parents, and children. Namely, changing the traditional approach to learning will depend on teacher's skill, but with preserving the coherence of the plan and program activities prescribed by the national curricula and achieving the set outcomes. By providing opportunities to discover and connect acquired knowledge from different subject areas, by solving "big questions" (Sugata, 2022), children develop skills for solving real-life and professional problems in extracurricular situations and the work environment. That is why some authors (Dart & Drake 1995) point out that the focus

of teaching should be shifted from learning through the subject disciplines to the integration into the system of knowledge from the STEAM field, which will be more applicable in a real life context. Teacher effectiveness in changing the learning paradigm towards the STEAM concept is a process, not a construct or program. As such, it depends on a large number of factors, of which one of the most important is teachers, their competence, motivation, and the assessment of self-efficiency for STEAM learning. Bandura (1977) established the construct of self-efficiency and described it as a belief in one's ability to succeed in performing certain actions and behaviors. In this sense, the self-efficiency of teachers for the implementation of learning according to the STEAM concept can be observed, because it captures the motivation, cognitive resources, and directions of action that are necessary for this. The author further emphasizes the difference between outcome expectations and self-efficiency expectations. While the former refers to beliefs that determine behaviors, which further result in certain outcomes, self-efficiency expectations concern the self-assessment of behavioral competencies to perform specific actions, in this case, for STEAM teaching (Coleman & Karraker, 1997). According to some sources, the most powerful means of self-efficiency is auxiliary experience (Fleig et al., 2013), which in this case means support and cooperation with teachers who have direct or indirect experience with leading STEAM classes. Although self-efficiency is not based on real knowledge and abilities, but rather on a personal experience of competence, it greatly influences real efficiency. In this sense, and due to the impossibility of realistic assessment of the representation and effectiveness of the STEAM concept of education, a self-assessment survey of nursery-school teachers and teachers was conducted on the above-mentioned questions, with the aim of determining the direction of development of STEAM teaching/learning.

METHODOLOGICAL FRAMEWORK OF THE RESEARCH

To determine the competencies for the STEAM approach of employees in preschool institutions and primary schools, a micro-survey was carried out in May 2024, at the level of preschool and primary education in the municipality of Raška, through the self-assessment of the respondents. An appropriate sample consisted of 30 respondents, the same number of nursery-school teachers, class teachers and subject teachers, employed in the Preschool institution Veselo detinjstvo and in the primary schools Raška and Sutjeska. Within the focus groups, a conversation was conducted based on the protocol, which contained the key determinants of the STEAM approach and key competencies for lifelong learning. The guided interview protocol contained questions that were

used in interviewing the respondents, divided according to research tasks. All three groups gave the common answer to the posed question; the answer was given by mutual thinking and defining. The first group of questions related to knowledge of the basic determinants of the STEAM approach in education, its importance, and the key disciplines that it is made of. The second segment of the questions examined the representation of the STEAM concept in pedagogical practice, its benefits and difficulties during its implementation, and overcoming them. The third group of questions was aimed at looking at the ways of developing competencies for the STEAM concept of education, that is the offer of the training and materials that support STEAM competencies.

THE RESULTS AND THE DISCUSSION

The first task of the research was related to understanding the STEAM concept.

By looking at the respondents' answers, it was determined that the respondents were familiar with this concept of education. Nursery school teachers believe that the STEAM concept is designed to prepare children for the professions that await them in the future through play, which can be realized through cooperation, improvement, developing skills, and connecting different topics using new technologies. The class teachers point out that the STEAM concept in students "develops creativity, critical thinking, and the ability to solve problems, which is very important as a preparation for lifelong learning." The subject teachers emphasize the importance of the intersubject correlation that the concept brings, as well as the importance of applying the acquired knowledge through practical examples and experience, that is, to develop functional knowledge.

The second task of the research was related to the examination of the representation of the STEAM concept in practice, benefits, difficulties, and possibilities of implementation in the educational system.

Based on the teacher's answers, it was determined that nursery school teachers apply the mentioned concept in accordance with their competencies and knowledge of new digital technologies during the development of a topic/project through an integrated approach to learning. There is no obligation to apply only this concept in the work. Preschool teachers believe that it is necessary to find ways to use new technologies for the benefit of children, as well as research and experimentation. They emphasize interdisciplinarity as a good side of the concept. The benefits for children are multiple, the child develops as a whole,

full of potential, competent, active, creative, and dedicated to learning through play and research. For the nursery school teachers, it is an opportunity to create a space together with children, research topics that are close to children, use resources in the environment to deepen research, initiate cooperation, and develop partnerships with colleagues, parents and the local community. It is important for parents to get involved and participate in the upbringing and education of their children, to empower the child, to spend more useful time with their children, to follow modern trends in education, and to prepare children as best as possible for the life challenges that await them. What could improve the concept, as nursery school teachers point out, is equipment, materials, and space, and all of these require certain financial resources. They also point out that the implementation of this concept in educational work creates opportunities for connecting and deepening knowledge, developing skills, progress, and well-being for all who participate in it. Despite understanding the concept and realizing its importance, class teachers lack practical experience. The results of the research imply that the mentioned concept has not been represented in the younger grades until now. The class teachers estimate that they do not have the necessary competencies to be able to implement it. Recognizing the benefits that the educational concept brings, among which they highlight the connection of knowledge from different fields, the development of skills, and the application of what has been learned in practice, teachers show interest in the mentioned program, but see the possibilities of implementation in educational work only after appropriate training. According to the self-assessments of the subject teachers, it can be concluded that the STEAM concept was represented in practice for a certain period during the project in which the schools were involved, and it was implemented by a group of teachers who developed competencies during the trainings within the project for the implementation of STEAM classes. Teachers note that the good sides of applying this concept are in children's greater interest in work, the acquired knowledge is more permanent when applied in practice, children are active in work, and knowledge is interdisciplinary and connected to solving problems and learning through play. Teachers also see benefits in team work – children are more motivated for work. Thus subject teachers also introduce diversity in the set way of working. As difficulties or factors that make it difficult to implement this concept in teaching, they point out the insufficient education of teachers, as well as the necessary material and technical resources. The teachers also note that "greater involvement of artistic fields is needed, which would contribute to the development of aesthetic competence and the development of creativity." The above statement is the result of the observations of teachers who teach art and music in primary school.

The third task of the research was related to the examination of how the respondents developed STEAM competencies.

Based on the research in focus groups, it was determined through the statements of respondents that nursery school teachers had the most opportunities to develop STEAM competencies, by attending training in this area through professional development program or webinars that they attended. Namely, all of them attended the training for the application of project learning, which includes the postulates of the STEAM concept. There was no training that would be in the function of STEAM learning for class teaching, while only a certain number of subject teachers were included in the training, and then they participated in the project and practically applied the STEAM learning concept. The positive attitude of all respondents and their interest in improving the competencies and skills in order to meet the challenges in the future upbringing and education of preschool and school children was noted.

CONCLUSION

Considering the accelerated social development and the need to develop key competencies for lifelong learning in children, a change in the paradigm of education is also necessary, which would meet their development and social progress. Although there are various models that promise greater efficiency in the realization of that goal, the key difficulty is created by the class-subject-hour system. As the STEAM concept of education is one of the models that can contribute to the holistic development of the personality and readiness to function in the society of knowledge, and its realization depends on the competence of teachers who need social support in this sense. Given that the respondents showed in their statements that they understand the STEAM concept, its benefits and the possibilities of implementation in pedagogical practice, and that they implement it to the extent that is possible, they also expressed the difficulties they face in this regard. The support they expect is contained primarily in understanding their position and the effort they invest, but also in the training they need, as well as the provision of material and technical resources. Support, which would also be significant in motivating the introduction of innovations, is seen in the understanding of colleagues and parents. Children certainly prefer to learn within the STEAM concept of education and show a higher degree of prosocial forms of behavior, according to the estimates of the respondents.

Given that the research sample was small and included respondents from only one municipality, the obtained results cannot be generalized to the

general population of respondents, although they may be very significant for the hypothetical framework of future research. It also seems important for future research to examine the role of art in the integrated curriculum, i.e. the contribution to the development of creativity, given that the intention of the STEM/STEAM concept is a critical reflection in the function of solving problems and coming up with new solutions.

REFERENCES

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2): 191–215. Available at: https://doi.org/10.1037/0033-295X.84.2.191

Bralić, Ž. (2016). Knowledge society and contemprary management. *Andragoške studije*, 1: 29–44. Available at: https://doi.org/10.5937/andstud1601029B

Breiner, J. M., Harkness, S. S., Johnson, C. C., & Koehler, C. M. (2012). What is STEM? A discussion about conceptions of STEM in education and partnerships. *School Science and Mathematics*, 112(1), 3–11. Available at: https://doi.org/10.1111/j.1949-8594.2011.00109.x

Ceylan, R.C. i Akçay Malçok, B. (2020). STEM Education Implementation at Early Age and Stakeholders' Opinions: The Case of Turkey. *Croatian Journal of Education*, 22 (3): 717–754. Available at: https://hrcak.srce.hr/247859

Coleman, P.K. & Karraker, K.H. (1997). Self-Efficacy and Parenting Quality: Findings and Future Applications. *Development Review*, 18, 47–85. Available at: http://dx.doi.org/10.1006/drev.1997.0448

Dart, P. & Drake, L. (1995). Mentors in English and mathematics. In: Reid I., Constable, H., & Griffiths, R. (eds), *Teacher Education Reform*, London: Paul Chapman.

Evropska komisija / EACEA / Eurydice (2012). *Developing Key Competences at School in Europe: Challenges and Opportunities for Policy*, Eurydice Report, Luksemburg: Ured za publikacije Europske unije.

Fleig, L., Pomp, S., Schwarzer, R. & Lippke, S. (2013). Promoting exercise maintenance: how interventions with booster sessions improve long-term rehabilitation outcomes. *Rehabilitation Psychology*, 58: 323–33.

Popović D. и Ristanović D. (2020). Potencijali projektne nastave za razvijanje međupredmetnih kompetencija, *Uzdanica,* XVII/2: 281–294. Available at: https://doi.org/10.18485/uzdanica.2020.17.2.19

Popović, D. i Beara, M. (2022). Projektnom nastavom ka međupredmetnim kompetencijama učenika. *Inovacije u nastavi - časopis za savremenu nastavu*, 35(2): 131–144. Available at: https://doi.org/10.5937/inovacije2202131P

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Scott, C. L. (2015). *The futures of learning 3: What kind of pedagogies for the 21st century?*, UNESCO Education Research and Foresight, Paris [ERF Working Papers Series, 15].

Soylu, R. A. S. (2016). STEM education in early childhood in Turkey. *Journal of Educational and Instructional Studies in The World*, 6(1): 38–47.

Sugata, M. (2022). *Škola u oblaku*, Beograd: Eduka.