Review scientific paper
UDK: 371.315.7:37.015.3]:51-057.874
DOI: 10.7251/SOCEN2526129L
COBISS.RS-ID 142905601
Paper received: 09.06.2025.
Approved work: 10.07.2025.

Slađana Lolić [1]

PROBLEM-BASED LEARNING AS A CONSTRUCTIVIST FRAMEWORK OF EARLY MATHEMATICS TEACHING: AN ANALYSIS OF STUDENTS' ATTITUDES

Abstract: *In the early stages of mathematics education, the foundation for successful learning lies in the development of logical, critical, and mathematical thinking. Teaching mathematics effectively means fostering students' ability to think independently and creatively, to solve problems and reason analytically. This research explores the impact of a problem-based, constructivist-oriented teaching approach on students' attitudes towards mathematics.*

The study compares the perceptions of students who experienced traditional instruction with those who participated in a problem-based learning program. The aim of the study is to determine whether younger primary school students who have mastered mathematical content through a problem-based learning approach develop more positive attitudes toward mathematics than those instructed through conventional teaching methods.

Using a Likert-type scale, student attitudes were assessed in terms of interest in mathematics content, perceptions of the teaching process, and the teacher's approach. The results indicate statistically significant differences in favor of the experimental group, demonstrating that constructivist methods contribute not only to cognitive achievement but also to the formation of more positive emotional and motivational dispositions toward mathematics.

The findings support the integration of constructivist principles into early mathematics instruction as a means to enhance student

1 PhD student at the University of Banja Luka, Faculty of Philosophy
lolics537@gmail.com

engagement and promote a deeper understanding of mathematical concepts. Recommendations include increasing the use of problem-based tasks and encouraging active, collaborative learning environments in which students construct knowledge meaningfully.

Keywords: *early mathematics education, constructivism, problem-based learning, student attitudes, teaching approaches*

Introduction

Mathematical contents are closely related to each other, so a misunderstanding of one part of the material can lead to a misunderstanding of all contents, which is why constant updating is required. The specificity of the early teaching of mathematics is reflected in its wide application, mathematical accuracy, logical rigor, and abstractness. A practical understanding of mathematics enables more successful and independent functioning. "The insistence on mathematical accuracy and logical rigor is reflected in the need for students to know, not only the facts in question, but also other elements on which these facts rely and from which they arise" (Sharma, 2001, p. 29). Mathematical content and activities should develop students' interest in mathematics. They also contribute to the development of logical thinking, the development of creative and critical thinking. Students should be motivated to overcome obstacles and find solutions to problems, i.e., to be creative. "Although creative inspiration is absolutely necessary, it is also important to understand that innovative ideas must also be practical" (Mouzas 2006, p. 1127).

From all of the above, it follows that effective early teaching of mathematics implies the active participation of students in the learning process with the aim of developing creativity, logical-mathematical thinking.

Early mathematics teaching

The value of early mathematics lessons in the educational sense is the formation of the student's personality, the development of the desire for truthfulness, the development of creativity, critical reflection, and reasoning, as well as the assessment of problem solving, problem situations, and the development of thought processes. The thought process is a special type of process that is regulated by internal mutual relations created within that process. "The very process of thinking consists in the transformations that the problem situation goes through" (Kvaščev, 1980, p. 77). The most accepted explanation of the flow in solving problem tasks, according to Vilotijević (1999, p. 150), is the one in which it is stated that it is a thought process consisting of four stages: a) getting to know the problem: the individual gets to know the elements of the problem, tries to understand their mutual connections and relationships; b) narrowing the problem: based on the analysis of the given data, the individual perceives what is given, what is the gap that needs to be filled, what is missing, he analyzes what is given taking into account the given and thus narrows down, concretizes the problems, vocalizes the difficulties and looks for a way to solve them; c) setting up a hypothesis: by analyzing the given, by observing and localizing the difficulties, the individual sets up a hypothesis for solving the problem; d) checking the hypothesis: when the hypothesis appears, the individual starts from the fact that it is correct and that he can fill in the gap in the given data; a hypothesis is a solution whose correctness needs to be verified.

Early mathematics teaching must be of high quality, interesting, dynamic, diverse, and constantly intellectually stimulating for students. Traditional ways of learning and teaching the content of early mathematics classes using different methods, forms, problems, logic, tasks of different levels of complexity, critical thinking and reflection is to awaken and encourage students to critically solve problem situations, constantly draw conclusions, connect teaching content and in this way nurture a critical review, instead of overloading and memorizing students with a large number of facts and tasks.

Theoretical starting point: constructivism in teaching

Constructivism, as a modern pedagogical-psychological direction, implies that the student actively builds their knowledge in interaction with the environment, in accordance with previous experiences and thought structures. Instead of passively receiving ready-made information, the student is placed in the center of the teaching process and encouraged to investigate, discover, set hypotheses, and test them through their own activity.

Hanfstingl et al. (2022) defined assimilation as the process of absorbing new information within existing mental schemas, while they described accommodation as the change or formation of new schemas when the existing ones are not sufficient - this is precisely the process that Piaget considers crucial for cognitive development. Lev Vygotsky emphasizes the importance of the social context and the concept of the zone of proximal development - students learn most effectively with the help of a more competent associate (teacher or peers), with gradual control over learning (Margolis, 2020).

Bruner (1960) proposed *a spiral curriculum*, in which basic ideas are *revisited, gradually expanded* and added to higher levels, to achieve *intuitive grasp and con-*

tinuous deepening of knowledge, while Kosheleva and Villaverde (2018) confirmed this application in mathematics education through repetition and systematic expansion of content at higher levels of complexity. In other words, students learn more easily and deeply if they are introduced through a gradual spiral structure of learning, from the concrete to the abstract (Kosheleva & Villaverde, 2018).

In this research, exactly those principles were applied: the teaching is organized in such a way that it includes problem-based tasks, encourages critical thinking and reflection, and enables students to play an active role in building knowledge. According to this type of teaching, according to Savery and Duffy (1996), problem-based learning in early mathematics can be seen through the following three constructivist understandings:

1. The understanding of some content depends on the student's experience and activities in some context.
2. Learning is the result of cognitive tension and conflict because facing a problem is a stimulus for learning.
3. Knowledge needs to be verified through collaboration with other students to determine what an individual knows in relation to others.

A constructivist-based upbringing - educational process that uses the problem method implies that the child is placed in a problem situation, which causes cognitive dissonance, encourages curiosity, an investigative spirit, and motivation to solve problems, which is desirable from an early age (Šindić, 2018). In this context, problem-based learning appears as a natural application of constructivism: students face tasks without previously known solutions, and through thinking, analysis, and collaboration, they come to new insights.

Problem learning in early mathematics teaching

In the 21st century, student creativity is one of the most important characteristics of successful students. Creativity has its roots in Latin terms meaning to create something new, to create something new, that is, it primarily refers to the ability to create and represents the characteristics that individuals should possess to create a new thought or material product. The modern word creativity-creation can represent "the power of creation, invention or production; artistic creation and participation in something useful or valuable" (Bognar & Solomanji, 2008, p. 69). It follows from this that creativity is a very important feature for creating new teaching models in the teaching process, and accordingly, innovative students.

"A creative student should think wisely, but at the same time be flexible and open to different alternatives" (Stevanović, 2003, p. 49). Therefore, the creative process is the process of arriving at creative solutions, which can be achieved in elementary mathematics classes by motivating students to find a large number of solutions to a given problem. By applying these methods of finding solutions in creative, unusual, and different ways, students become more creative in the teaching process. This leads to the development of students' creative thinking, the teaching process becomes more creative, and the student and the environment in which the student resides, i.e., the school environment, becomes a more comfortable and positive place for the student's creative work, i.e., the student creatively acquires knowledge.

Problem solving is one of the highest forms of learning. Savery and Duffy (1996) believes that theory should be applied in practice, which will lead to building knowledge and skills and structuring problems. While solving a problem, the student is in a research position, in which he initiates creative thinking, which implies high levels of acquired knowledge and adopted skills. According to Horvat (2019), problem tasks should be a link between mathematical content and everyday life, and unfortunately, research shows that such tasks are insufficiently done in elementary school, because this form of work and learning requires enormous effort and commitment from both students and teachers. The teacher must be well prepared for the problem lesson. It is extremely important to take into account the relationship between the concrete and the abstract in the initial teaching of mathematics. "For the child to reach a higher level, he must first be exposed to concrete physical experiences and learn new discoveries over time, i.e., logical-mathematical experience" (Sharma, 2001, p. 66). That is why it is necessary to lead students to master mathematical content in a creative, creatively interesting way, and we achieve this by solving problem tasks and situations, by introducing tasks and content that will not be boring to them, that is, that will deepen critical thinking and reflection.

In any case, the learning of mathematics should begin with the introduction of problems that are adequate to the students' real situation (contextual problem). Yusof et al. (2012) explain that the problem-based learning model begins with an unstructured problem that has more than one answer. Hmelo Silver (2004), synthesizing studies on problem-based learning, observes that it leads to deeper, more flexible mental models and more permanent knowledge. Problem tasks place students in a research position in which their creative thinking is encouraged, opening up space for multiple solutions, different approaches, and personal reflection (Horvat, 2019; Savery & Duffy, 1996). Such approaches allow not only a deeper understanding of mathematical concepts but also a more pleasant emotional learning experience.

It is in this context that students' attitudes towards mathematics should be observed, which are often negative or at least reserved, especially when the teaching is based on mechanical learning, reproduction, and abstract tasks without a deeper meaning for the child. Starting from the understanding that attitude is the learned tendency of an individual to react positively or negatively to a certain concept, situation, object, or other person (Aiken, 1970), the attitude towards mathematics can be understood as a combination of emotional experience and beliefs that students develop in contact with mathematical content. In other words, if students perceive mathematics teaching as meaningful, challenging, yet accessible and creative, they are more likely to develop a positive attitude towards this subject.

Contemporary international research (Obeng, 2025; Gómez-Chacón et al., 2024; Zamir et al., 2023) indicates that constructivist approaches in teaching, among which problem-oriented teaching has a special place, contribute to the formation of more positive attitudes of students towards mathematics. Despite these findings, in the educational context of Bosnia and Herzegovina, such research is still few.

Bearing that in mind, the subject of this research examines the attitudes of fifth-grade elementary school students about mathematics, intending to determine whether the problem-based approach in teaching contributes to the development of more positive attitudes compared to the traditional approach.

Research methodology

The research was carried out as a quantitative experimental study with parallel groups - experimental and control - to examine the effects of problem-oriented mathematics teaching and the attitudes of fifth-grade elementary school students. The aim of the study is to determine whether younger primary school students who have mastered mathematical content through a problem-based learning approach develop more positive attitudes toward mathematics than those instructed through conventional teaching methods.

The research design included a comparison of two groups of students who were exposed to different forms of teaching during one school semester.

Following the research objective, the following hypothesis was put forward:

Fifth-grade students who learned mathematical content through a problem-based approach will show more positive attitudes toward mathematics compared to students who participated in traditional classes.

The research sample consisted of 190 fifth-grade students, formed by a deliberate selection from two city elementary schools in Banja Luka - Elementary

School "Ivo Andrić" and Elementary School "Branko Ćopić". The schools were selected due to their similar pedagogical and socio-economic profile, thus ensuring basic comparability of the context. The sample was additionally standardized on the basis of previous school success in mathematics and the results of the knowledge test, which was applied before the start of the experiment, which increased the internal validity of the research.

The experimental group (N = 95) learned mathematics content through problem-oriented teaching during one school semester. Within the experiment, an innovative approach was applied that included different models of interactive and collaborative learning, and the teaching activities were problem-based, designed to encourage research thinking, logical reasoning, and active participation of students.

In the control group (N = 95), the teaching of mathematics was carried out in the traditional way - face-to-face, with the use of textbooks, teaching sheets, and reproductive work methods. During the experimental period, both groups studied the same teaching content, in the same number of lessons, within the regular curriculum.

The instruments used in all phases of the research were partially taken from existing validated research, while the other part of the instruments was developed independently, taking into account the age of the students and the goals of the study. The main instrument was a questionnaire with a Likert scale, which included several elements: students' attitudes towards mathematics, interest in learning, perception of teaching, and attitudes about the teacher's approach. The first scale measured the general attitude towards mathematics and contained 15 statements, with an acceptable level of reliability ($\alpha = .65$). The second scale included students' attitudes about interest in learning, about the teaching itself and about the teacher's approach, with a high overall reliability ($\alpha = .88$). The results were separately analyzed for three subdimensions: interest in learning elementary mathematics ($\alpha = .69$), perception of teaching ($\alpha = .79$) and assessment of the teacher's approach to teaching ($\alpha = .82$).

The data were processed in the SPSS program, using descriptive statistics (arithmetic mean, standard deviation), the Kolmogorov-Smirn test for determining the normality of variable distributions, the t-test for independent samples (to examine the differences between the experimental and control groups), as well as one-factor analysis of variance (ANOVA) (to examine the connection between school and school success on student attitudes). The level of statistical significance was set at $p < .05$.

Research results

After the application of the experimental program, it was examined whether the students of younger school age who mastered the contents in the early mathematics lesson using a problem-based approach to learning will express more positive attitudes towards mathematics compared to the students of the control group who learned in the usual way in traditional teaching, that is, whether the students of the experimental group will achieve statistically more positive attitudes about interest in mathematics compared to the students of the control group. For this purpose, a Likert-type scale of *Student Attitudes on Mathematics* was applied. The normality of the distribution of variables was tested with the Kolmogorov–Smirnov test, which confirmed the prerequisite for the application of parametric statistical procedures, including the *t*-test and analysis of variance (ANOVA).

Table 1 shows the results determined at the end of the experiment.

Table 1. Students' attitudes about mathematics in relation to the group

Group	*N*	*M*	*SD*	*t*	*df*	*p*
C	95	49.02	6.39	-2.10	188	.037*
E	95	51.29	8.38			

* A statistically significant difference was determined at the level of .05

Based on the data shown in Table 1, it was observed that the attitudes of the students of the experimental group towards mathematics were more positive compared to the attitudes of the students of the control group. Students in the experimental group demonstrated a higher mean score (M = 51.29; SD = 8.38) compared to students in the control group, whose mean score was lower (M = 49.02; SD = 6.28).The average value of the attitude of the students of the experimental group was 3.42, while the average value of the students of the control group was 3.27.

A slightly positive attitude was recorded in both groups, given that the average value was higher than 3. The students of the experimental group showed a higher arithmetic average and more homogeneous attitudes about interest in mathematics compared to the students of the control group. Based on statistical indicators ($t = -2.10$, $df = 188$, $p = .037$), a statistically significant difference was found between the attitudes about mathematics among the students of the control and experimental groups, at a significance level of .05.

However, it is important to note that students' attitudes and beliefs are slowly formed and consolidated, especially in younger school age. The duration of the experimental program, i.e., learning mathematical content through a problem-based approach, contributed to the achievement of a statistically significant difference.

The second task was to examine the differences in the attitudes of the students who participated in the experimental research on the characteristics of early mathematics classes: that is, on the students' interest in learning the content of early mathematics classes, on problem-based teaching, and on the teacher's approach to teaching. The results are presented and analyzed separately according to the parts of the applied *Scaler: Students' attitudes about interest in learning, about teaching, and about the teacher*. Table 2 shows the representation of students' views on interest in learning elementary mathematics classes in relation to the group.

Table 2. Students' interest in learning the content of early mathematics classes in relation to the group

Group	*N*	*M*	*SD*	*t*	*df*	*p*
C	95	35.08	7.15	-2.48	188	.014*
E	95	37.29	4.94			

* A statistically significant difference was determined at the level of .05

The results of the application of the scale showed that after the implementation of the experimental program, the students of the experimental group showed a higher degree of interest in learning the content of the early mathematics lessons compared to the students of the control group. Among the students of the experimental group, a higher arithmetic mean (M = 37.29) and greater homogeneity in attitudes, i.e. less dispersion (SD = 4.49), was found, compared to the students of the control group, where the arithmetic mean was lower (M = 35.08), and the dispersion was greater (SD = 7.15).

Based on the average value of the attitude, which was 3.73 for the students of the experimental group and 3.51 for the students of the control group, it can be concluded that in both cases, slightly positive attitudes towards the learning of mathematical content were identified.

Based on the statistical indicators (t = –2.48, df = 188, p = .014), a statistically significant difference was found between the attitudes of the students of the experimental and control groups regarding their interest in learning content from the early mathematics classes, at a significance level of .05.

Table 3 shows the results of students' attitudes regarding teaching in relation to the group.

Table 3. Students' attitudes about mathematics teaching in relation to the group

Group	*N*	*M*	*SD*	*t*	*df*	*p*
K	95	39.09	6.00	-.29	188	.78
E	95	39.34	5.71			

Based on the data shown in the previous table, it was observed that the students of the experimental group had a slightly more positive attitude towards teaching compared to the students of the control group. The students of the experimental group evaluated problem-based teaching, and the students of the control group evaluated traditional teaching. Based on statistical indicators ($t = -0.29$, $df = 188$, $p = .78$), it was determined that there was no statistically significant difference. However, this does not imply that problem teaching was not effective.

It was concluded that the students from both groups assessed the quality of teaching approximately similarly, which indicates that traditional teaching also has certain values. Based on the average attitude values, which were 3.91 for the control group and 3.93 for the experimental group, it was observed that the attitudes were slightly positive. These results indicated the need for additional educational activities for students, regardless of the type of teaching. Constantly encouraging and motivating students through various activities and procedures is necessary in the process of learning the content from the early mathematics classes.

Apart from the students' interest in learning the contents of the early mathematics classes and the assessment of the implemented classes, the students' attitude about the teacher's approach in classes is also significant.

In the experimental group, the teachers applied the problem-based approach, while in the control group, they applied the traditional approach. Data on how the students of the control and experimental groups evaluated the teachers' approaches are shown in Table 4.

Table 4. Students' attitudes about the teacher in relation to the group

Group	*N*	*M*	*SD*	*t*	*Df*	*p*
C	95	38.26	5.90	-2.05	188	.042*
E	95	39.94	5.34			

*A statistically significant difference was determined at the level of .05

At the end of the school year, the students of the control and experimental groups evaluated the teacher's approach in teaching similarly. In both cases, a slightly positive attitude was recorded, whereby the average value of the attitude was 3.83 among students of the control group and 3.99 among students of the experimental group. Nevertheless, statistical indicators ($t = -2.05$, $df = 188$, $p = .042$) indicated the existence of a statistically significant difference between students' attitudes about the teacher's approach, in favor of the experimental group, at the level of $p = .05$.

The attitude of the students about the teacher's approach is of particular importance because, in contrast to the assessment of teaching, it was precisely in this dimension that a statistically significant difference was shown in favor of the problem-based approach.

Discussion

The results of the research show that the experimental program of problem-based learning has a positive impact on students' attitudes towards mathematics and on their interest in learning the content of early mathematics classes. Statistically significant differences in favor of the experimental group ($t = -2.10$; $p < .05$ and $t = -2.48$; $p < .05$) confirm that the problem-based approach contributes not only to cognitive, but also to affective learning outcomes. Also, Obeng (2025) in his research in a secondary school context found that PBL has a positive effect on students' self-confidence and affective attitude towards mathematics. Also, Gómez-Chacón et al. (2024) confirms with his research that different approaches to constructivist-based teaching contribute to the improvement of attitudes towards mathematics in terms of the perceived usefulness of mathematics and self-knowledge regarding mathematical competences.

Interestingly, the perception of the teaching itself is not significantly different between the experimental and control groups. This finding indicates that students, even when exposed to different work methods, may have a similar overall experience of teaching. This may mean that even traditional teaching has certain values that students recognize and appreciate. The perception of teaching among students did not show significant differences between the groups, which confirms the conclusions of the research by Zamir et al. (2023) that students' attitudes about teaching do not only depend on the method of work, but also on additional factors such as motivation, self-confidence and the value that mathematics has for the student. Also, the factors that could influence the perception of teaching may be related to other factors such as the experience and perception of the teacher and the feeling of involvement.

The most notable positive effect of problem-based mathematics learning in our study was observed precisely in the way students assessed their teachers' approach ($t = -2.05$; $p < .05$), which indicates that the teacher's approach is a key component in shaping students' affective attitudes towards mathematics. This result indicates that the problem-based approach not only affects the attitudes towards the subject, but also the way students perceive the teacher. Likely, greater interaction, the possibility of expressing opinions, and openness in work contribute to this experience.

Additionally, Cazzola (2018) points out that in the context of problem-based learning, the teacher's role is not to convey ready-made knowledge but to create opportunities for students to discover mathematical concepts through the research process, which encourages deeper understanding and greater emotional engagement of students. In accordance with Piaget's understanding that the child actively constructs knowledge through experience, problem tasks stimulate thought development through concrete situations, while Vygotsky emphasized the importance of social interaction and verbalization within the zone of proximal development, which is at the core of the problem-based approach. Boaler (1998) points out that students develop a more positive attitude towards mathematics when they have a sense of autonomy and when knowledge is connected to real contexts. Thus, the affective and cognitive components of learning become inseparable, and the teacher becomes a mediator and supporter, not an authority. The findings of this study point to the need to redefine the role of the teacher in modern mathematics teaching, from a passive transmitter of knowledge to an active designer of an environment for research, collaboration, and dialogue. Such practice also requires appropriate initial training, which Cazzola (2018) points out, calling for changes in the education programs of future teachers.

Taken as a whole, problem-based learning is an approach that improves both educational and upbringing outcomes. Its application is recommended, noting that it would be useful to conduct longitudinal studies to determine whether the positive effects are permanent and whether they persist in later grades.

One of the key limitations of this study is the duration of the experimental program, which was limited to one school semester. Although the results showed statistically significant differences in students' attitudes, it is possible that a longer period of implementation would allow for deeper and more stable formation of attitudes, as well as more lasting changes in learning.

Conclusion

The results of the research indicate that problem-oriented teaching of mathematics, based on constructivist principles, contributes to the formation of more positive attitudes of students of younger school age towards mathematics. Students who learned through problem tasks showed a greater interest in learning, a higher level of engagement, and a more positive perception of the teacher and the teaching process compared to students who were involved in traditional teaching.

Although not all differences were found to be statistically significant, the application of the constructivist approach in early mathematics teaching shows the potential for improving both educational and upbringing outcomes. Positive attitudes towards mathematics must be formed in this developmental period because they later influence the student's motivation, self-confidence, and success in mathematics.

It is recommended that early mathematics teachers apply problem tasks to a greater extent, encourage thought processes, and enable students to actively build their knowledge through research, collaboration, and reflection.

Introducing constructivist methods not only contributes to academic achievement but also shapes lasting attitudes towards learning as a meaningful and challenging process.

Literature

1. Aiken Jr, L. R. (1970). Attitudes toward mathematics. *Review of Educational Research*, *40*(4), 551–596.
2. Bognar, L., & Somolanji, I. (2008). Kreativnost u osnovnoškolskim uvjetima. *Život i škola: časopis za teoriju i praksu odgoja i obrazovanja*, *54*(19), 87–94. [Bognar, L., & Somolanji, I. (2008). Creativity in elementary school settings. *Life and School: Journal of Theory and Practice of Education*, 54(19), 87–94.]
3. Boaler, J. (1998). Open and closed mathematics approaches: Student experiences and understandings. *Journal for Research in Mathematics Education*, *29*(1), 41–62. https://doi.org/10.2307/749717
4. Bruner, J. S. (1960). *The process of education.* Harvard University Press.
5. Cazzola, M. (2018). Problem-based learning and teacher training in mathematics: How to design a math laboratory. In L. Gómez Chova, A. López Martínez, & I. Candel Torres (Eds.), *INTED2018 Proceedings* (pp. 9038–9043). IATED. https://doi.org/10.21125/inted.2018
6. Gómez-Chacón, I. M., Bacelo, A., Marbán, J. M., & Palacios, A. (2024). Inquiry-based mathematics education and attitudes towards mathematics: Tracking profiles for teaching. *Mathematics Education Research Journal*, *36*(3), 715–743. https://doi.org/10.1007/s13394-023-00468-8

7. Hanfstingl, B., Arzenšek, A., Apschner, J., & Gölly, K. I. (2022). Assimilation and accommodation: A systematic review of the last two decades. *European Psychologist*, *27*(4), 320–337. https://doi.org/10.1027/1016-9040/a000463
8. Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, 16, 235–266. https://doi.org/10.1023/B:EDPR.0000034022.16470.f3
9. Horvat, Z. (2019). Didaktičko-metodičke kompetencije nastavnika matematike [Doktorska disertacija, Filozofski fakultet]. { Horvat, Z. (2019). Didactic-methodical competences of mathematics teachers [Doctoral dissertation, Faculty of Philosophy]}
10. Kvaščev, R. (1980). *Podsticanje i sputavanje stvaralačkog ponašanja ličnosti* (2. dopunjeno izd.). IGKRO Svjetlost, OOUR Zavod za udžbenike. [Kvaschev, R. (1980). *Encouraging and inhibiting the creative behavior of a person* (2nd amended ed.). IGKRO Svjetlost, OOUR Zavod za udžbenike.]
11. Kosheleva, O., & Villaverde, K. (2018). *Spiral Curriculum: Towards Mathematical Foundations.* In *How Interval and Fuzzy Techniques Can Improve Teaching* (Studies in Computational Intelligence, Vol. 750, pp. 135–145). Springer. https://doi.org/10.1007/978-3-662-55993-2_15
12. Margolis, A. A. (2020). The zone of proximal development and organization of students' learning activity. *Psychological Science and Education*, *25*(4), 6–27. https://doi.org/10.17759/pse.2020250402
13. Mouzas, S. (2006). Efficiency versus effectiveness in business networks. *Journal of Business Research, 59*(10–11), 1124–1132. https://doi.org/10.1016/j.jbusres.2006.09.018
14. Obeng, B. A. (2025). Investigating the impact of problem-based learning on students' attitudes toward mathematics. *International Journal of Advanced Research*, *13*(4), 514–522. https://doi.org/10.21474/IJAR01/20747
15. Savery, J. R., & Duffy, T. M. (1996). Problem based learning: An instructional model and its constructivist framework. Educational Technologies.
16. Stevanović, M. (2003). *Modeli kreativne nastave*. Znanje. [Stevanović, M. (2003). *Models of creative teaching*. Znanje.]
17. Sharma, M. (2001). *Matematika bez suza: Kako pomoći djetetu s teškoćama u učenju matematike*. Ostvarenje. [Sharma, M. (2001). *Mathematics without tears: How to help a child with difficulties in learning mathematics*. Ostvarenje.]
18. Šindić, A. (2018). *Upoznavanje predškolske djece s okolinom i društvenom sredinom.* Univerzitet u Banjoj Luci, Filozofski fakultet. [Šindić, A. (2018).

Acquaintance of preschool children with the environment and social environment. University of Banja Luka, Faculty of Philosophy.]

19. Yusof, K., Hassan, S., Jamaludin, M., & Harun, N. (2012). Cooperative problem-based learning (CPBL): Framework for integrating cooperative learning and problem-based learning. *International Conference on Teaching and Learning in Higher Education (ICTLHE)*. https://doi.org/10.1016/j.sbspro.2012.09.649
20. Zamir, S., Yang, Z., Wenwu, H., & Sarwar, U. (2023). Assessing the attitude and problem-based learning in mathematics through PLS-SEM modeling. *PLOS ONE*, 17(5), Article e0266363. https://doi.org/10.1371/journal.pone.0266363