Psychological Thought
psyct.swu.bg | 2193-7281
South-West University "Neofit Rilski"

Research Article

The Role of Innovative Approaches in Mathematics Education at the Primary School Level: Psychological Perspectives

Elena Karashtranova*[a]

[a] Department of Informatics, South-West University "Neofit Rilski", Blagoevgrad, Bulgaria.

Abstract

This article presents the psychological aspects of introducing and implementing innovative approaches in mathematics education at the primary school level. As the issue of anxiety and stress within the educational system (both among teachers and students) is becoming increasingly relevant and widely studied due to its deep consequences for overall mental and physical health, the article explores some of the main sources of stress and anxiety among students, with an emphasis on integrating innovative methods and techniques into pedagogical practice, such as robotics. The research presented in this article involves 106 participants, 51 of whom are primary school teachers and 55 are students from pedagogical specialties. 86 of the participants are women and 20 are men. An interesting trend is the higher degree of acceptance of robotic applications among future teachers compared to practicing teachers. A similar difference is observed in attitudes regarding the impact of robotic applications on students' cognitive development. Future teachers are more likely to agree with the benefits of robotic applications on students' cognitive development. A larger percentage of future teachers believe that they will make mathematics more attractive, while only 17.6% of practicing teachers share this view. Future teachers demonstrate a higher degree of acceptance and optimism toward innovative technologies. Practicing teachers show more reservation, distrust, and uncertainty. Researching attitudes towards robotic applications in primary school mathematics education could contribute to expanding the understanding of the importance of this approach, which influences not only future academic achievements but also the overall psycho-social development of the individual.

Keywords: innovative approaches; school environment; psychological characteristics; primary school age; coping strategies; anxiety; stress; educational process; robotic applications.

Table of Contents

Psychological Thought, 2025, Vol. 18(1), 359-374, https://doi.org/10.37708/psyct.v18i1.1108
Received: 2025-02-15. Accepted: 2025-04-01. Published (VoR): 2025-05-02.
Handling Editor: Irina Roncaglia Independent, Private Practice, United Kingdom. *Corresponding author at: Department of Informatics, South-West University "Neofit Rilski", Blagoevgrad, Bulgaria. E-mail: helen@swu.bg

Mathematics education in primary school plays a key role in developing fundamental thinking and problem-solving skills (Duma et al. 2024; Kaitera & Harmoinen, 2022; van Oers, 2024). Over the past few decades, mathematics education has undergone significant transformations, shifting from traditional teaching methods to innovative approaches designed to meet the modern demands of the educational system. Difficulties in understanding abstract mathematical concepts often create barriers to students' full grasp of the material. As a result, in recent years, the gradual introduction and application of innovative approaches, including new technologies, game-based methods, multimedia resources, and robotic applications, has emerged as a strategy in pedagogical practice (Paaskesen, 2020). The goal is to enhance students' interest and engagement. This creates a dynamic and interactive learning environment that encourages active learning and the practical application of knowledge. The inclusion of robotics, platforms, and different scenarios in the learning process opens new opportunities for developing mathematical skills, while also encouraging students to think creatively and solve problems. It is expected that within the next 2-3 years, most schools in Bulgaria will be equipped with STEM classrooms (Papancheva & Dermendzhieva, 2021; Topalska, 2021; Zhelyazkova, 2023). The relevance of using innovative approaches in mathematics education is particularly important in the context of modern educational trends and the rapid development of technologies. Numerous studies show that innovative methods can significantly improve student success in primary school and help develop positive attitudes towards mathematics from an early age (Bers, 2018; Fuchs et al., 2010; Aro, 2020). The effectiveness of these methods depends on their careful integration into the

educational process, as well as on specialized training for teachers to use new technologies and approaches in ways that meet the needs and capabilities of students at various age stages.

Psychological Characteristics of Primary School Age: There are various theoretical directions in psychology that describe the psychological characteristics at different stages of development. This article presents only some of them, directly related to the focus of the theoretical framework and research design. Primary school age (7-10 years) is a transitional period between early childhood and middle childhood. This period is characterized by increased cognitive activity, the formation of study habits, and the development of social identity. According to Erikson's theory, children at this age are in the stage of "industry vs. inferiority," where success in school contributes to building self-confidence (Erikson, 2013). The school environment can influence the child's self-esteem and social adaptation (Rahmatika & Hernawati, 2016).

According to Jean Piaget (Singer-Freeman, 2005), primary school age falls into the concrete operational stage of cognitive development. Key characteristics of this stage include:

- development of logical thinking and understanding of cause-and-effect relationships;
- improved ability for classification, serialization, and reversibility of mental operations;
- increased ability to sustain attention and develop working memory;
- development of metacognitive skills and self-reflection;
- improvement in language skills and vocabulary expansion (Lazarova, 2022).

The main skills that children need to acquire in order to succeed in mathematics education are discussed in this text:

Cognitive Skills

These abilities play a key role in mathematical thinking. Among them, the following stand out:

- Understanding numbers and numerical operations: Students must develop the ability to recognize, compare, and manipulate numbers. Understanding the components of numbers and their hierarchy helps in mastering arithmetic operations (Geary, 2013).
- Logical thinking and reasoning: The development of logical thinking supports the ability to solve tasks through analysis and deduction. This includes understanding cause-and-effect relationships and applying problem-solving strategies (Baroody, 2006).

- Spatial thinking: Geometric tasks require the ability to visualize objects and understand spatial relationships, which is important for forming mathematical concepts (Mix & Cheng, 2012).

Practical Skills

- Working with mathematical symbols and signs: The ability to interpret and use mathematical notations (Fuchs et al., 2010).
- Application of various problem-solving strategies: Children should be taught different techniques for finding solutions, such as using diagrams, breaking down numbers, and checking results (Kilpatrick et al., 2001).
- Ability to work with word problems: Understanding the conditions of problems and translating them into mathematical language. Improving literacy skills can support this process (Jordan et al., 2003).

Psychological Factors Important for Success in Mathematics:

- Confidence in one's abilities: A positive attitude towards mathematics and belief in success support students' achievements (Wigfield & Eccles, 2000).
- Developing resilience to mistakes: Children need to learn to accept mistakes as part of the learning process and develop the ability to correct them (Boaler, 2016).
- Motivation and engagement: Intrinsic motivation and interest in mathematics increase the desire to learn and acquire new knowledge (Ryan & Deci, 2000).

In the context of the discussed age group, the interest of researchers in connection with the experiences of anxiety and stress in the educational process and the school environment as a whole remains persistent. Anxiety in children can arise due to a variety of external and internal factors. It can be a physical condition, an emotion, or troubling beliefs and thoughts. It may also be perceived as a milder form of fear. Most children experience anxiety from time to time, while others may be anxious most of the time. Anxiety affects the body, emotions, thoughts, behavior, and the child's relationship with others. As such, it manifests and is experienced differently in each child (Beck, 2000). According to the American Psychological Association, anxiety is an emotional state characterized by feelings of tension, worry, and physiological changes such as an accelerated heart rate and increased sweating (American Psychological Association, 2020). According to Beck, anxiety can be divided into two categories: state anxiety (a temporary reaction to a stressful situation) and trait anxiety (a more deeply rooted personality characteristic) (Beck, 2000).

Research by Levin suggests that anxiety in children is often connected to their personal experiences and emotional state, and can manifest in various forms, such as: social anxiety, fear of failure, generalized anxiety, and others. Children in primary school age may experience anxiety due to new social situations, demands in the educational process, or fear of negative evaluations. Children who are excessively anxious may worry that they are not smart enough because they know they sometimes act irrationally (Levin, 2023). Studies show that children in primary school experience both stress and anxiety, but in different ways (Wigfield, et al., 2000). In everyday language, the terms stress, anxiety, and worry are often used interchangeably. In psychology and psychiatry, specific nuances are distinguished, in which anxiety and stress are similar but also differ. Both conditions involve feelings of tension and physiological reactions, such as an increased heart rate and sweating. Both stress and anxiety can be triggered by external factors, such as academic pressure and social situations. Prolonged exposure to stress or anxiety can lead to health issues (Fuchs et al., 2010). Although they are similar in some aspects, there are also several key differences between the two conditions. Stress is usually a reaction to a specific external stimulus (e.g., an upcoming exam), while anxiety is often defined as an undefined fear without a specific cause. Anxiety is a more prolonged condition, whereas stress is more often temporary and reactive.

A study by Weems and colleagues found that children between the ages of 6 and 10 develop anxiety as a result of social pressure and expectations for academic success (Weems et al., 2010). Another study by Mian and colleagues indicates that children exposed to chronic stress are more likely to develop anxiety disorders later in life (Mian et al., 2011). Nelson and Leung (2019) found that family support and the school environment can play a crucial role in regulating anxiety and stress in children (Nelson & Leung 2019).

In summary, the main sources of children's anxiety and stress in the learning process at the primary school level are:

- **Physical factors** – lack of sleep, unhealthy eating, lack of exercise;
- **Academic pressure**, which includes: high expectations from teachers and parents, as well as difficulties in understanding and mastering the study material;
- **Overloaded schedule** – excessive amounts of academic and extracurricular activities;
- **Unclear expectations and changes in the learning environment** – teacher changes, transitions between grades, new rules;

- **Teaching methods** – lack of individualized approaches and insufficient interactive methods can increase stress in students;
- **Fear of failure**, often caused by anxiety related to grades, exams, and homework;
- **Social relationships**, expressed in difficulties communicating with peers, teachers, bullying, and conflict situations, as well as competition in the classroom;
- **Family factors** – family tension, divorce, loss of a loved one (Aro, 2020; Bowers, 2019).

Strategies for Coping with Stress and Anxiety in Children at School: Managing school stress and anxiety requires an integrated approach involving students, parents, and teachers. Among the most effective strategies are:

- **Development of self-regulation skills**, such as deep breathing techniques, meditation, relaxation, physical activities, and good time management, which can help children reduce their stress levels (Zimmer-Gembeck & Skinner, 2011).
- **Creating a supportive learning environment**: Teachers and parents should foster a positive, inclusive, and supportive learning environment where children feel confident, supported, and motivated (Pianta, 1999).
- **Balance between academic and extracurricular activities**: It is essential for children to have time for rest and play, which promotes their emotional well-being (Fredricks & Eccles, 2006). A balanced approach to education is key, as excessive pressure from exams, tests, and tasks, combined with a lack of space for creativity and imagination, can increase stress (Aro, 2020).
- **Development of social skills** – Training in emotional intelligence and communication skills can help children cope more easily with social challenges.
- **Supportive family environment** – Research shows that when parents actively engage in their child's learning, providing support during tough moments and offering positive feedback, children are less susceptible to stress (Bowers, 2019).
- **Introduction and implementation of robotic technologies in educational practice.**

This article specifically focuses on the teaching of mathematics. Robots in the classroom offer practical and realistic situations that require the application of mathematical knowledge. Children can use mathematics to solve specific tasks related to the movement, positioning, and behavior of robots. For example, robots can be programmed to follow different paths or perform tasks such

as drawing geometric shapes, with each movement requiring the calculation of distances, angles, and trajectories. Additionally, robots provide an opportunity to explore geometry through the visualization of shapes and volumes in the real world. For instance, children can program a robot to follow a specific route using different geometric shapes such as squares, triangles, or circles. Through the physical movement of robots, children can grasp concepts like angles, perimeters, areas, and volumes in a much more accessible and fun way than through traditional teaching methods. This allows students to see "live" examples of these geometric objects, measure and calculate in real time, as well as change parameters and observe the consequences of these changes. Through games, challenges, and visual demonstrations, robotic applications can engage children in educational scenarios that both entertain them and facilitate their understanding of mathematical concepts, logical and numerical operations. Robotic technologies offer children the opportunity to become acquainted with the basics of algorithmic thinking. Robots can be programmed to make measurements using basic mathematical operations (addition, subtraction, multiplication, division) and perform calculations that are used to analyze data obtained from various sensors. Fun exercises, such as counting objects or playing number-based games, help children associate numbers with real-life objects and actions. Additionally, they can visualize numerical sequences or different geometric shapes to enhance their visual understanding of the subject.

Last but not least, robotic technologies provide children with the opportunity to work in teams, which develops their communication and social skills. Children working in groups learn to cooperate in problem-solving, to delegate tasks, and to discuss different approaches to solving mathematical problems. This not only enhances their mathematical literacy but also develops their ability to work together and share ideas, which helps reduce anxiety. Research shows that robotic applications in primary education not only maintain students' interest but also significantly improve their understanding of abstract concepts, such as mathematical operations and geometry (Bers, 2018). Robots can serve as practical examples that visualize theoretical mathematical ideas, encouraging curiosity and expanding students' mathematical abilities (Sullivan & Habib, 2020). For example, with the help of robotic platforms, students can familiarize themselves with concepts such as symmetry, perimeter, and volume in a practical and visual way.

The aim is to explore the attitudes of current and future teachers regarding the introduction and application of robotic applications in the mathematics educational process, as well as the related constructs of stress and anxiety that accompany these innovations.

Hypothesis: It is assumed that there is a significant difference in the attitudes of current and future teachers regarding the integration of robotic applications in the primary school mathematics education process.

Method

Participants: This research involves 106 participants, 51 of whom are primary school teachers and 55 are students from pedagogical specialties. 86 of the participants are women and 20 are men.

Instrument and Procedures

An online survey created in Google Forms was conducted. The first part of the survey collected demographic data such as gender and status. The second part consists of 17 questions related to the use of robotic applications in mathematics education, using a 5-point Likert scale for responses ranging from 1 - "Strongly disagree" to 5 - "Strongly agree." Additionally, an interview was conducted with 36 participants, where they answered 4 open-ended questions related to the greatest challenges for children in mathematics education, specifically regarding anxiety and stress. The survey was conducted between December 7, 2023, and January 16, 2024.

Ethical Principles

The study was conducted voluntarily and anonymously. The responses from the survey and interviews are used solely for the purposes of this research, which is part of the international project **RbtcsInEdu**, implemented jointly with universities from Latvia, Warsaw, and others.

Data Processing Methods:

The collected data from the study were processed using the statistical program SPSS, version 23. To test the proposed hypothesis and achieve the aim of the study, the non-parametric statistical procedure of chi-square analysis was applied. Additionally, a content analysis was used for processing the data from the interviews.

Results

The results from the content analysis show that nearly 80% of the current and future teachers surveyed believe that there is anxiety, worry, and stress among students in primary school mathematics education. Almost 50% of future teachers believe that the introduction and

application of robotic applications would contribute to reducing the level of anxiety and stress among students in the process of learning mathematics.

To establish differences in attitudes between pedagogical students and current teachers in the Bulgarian education system regarding the introduction and application of robotic applications in mathematics education, the non-parametric chi-square method was applied. The results support statistically significant differences between the groups on several parameters: 36.4% of pedagogical students fully agree that robotic applications would make mathematical tasks more meaningful for students, compared to 33.3% of current teachers who somewhat agree with this statement ($\chi^2(4) = 12.443$; $p = .014$).

A statistically significant difference is also observed regarding the statement that "robotic applications will improve the cognitive thinking process in students" ($\chi^2(4) = 16.044$; $p = .003$). Nearly 53% of future teachers fully agree with this statement, compared to only 18% of current teachers, though nearly 40% of them somewhat agree. 15.7% of current teachers disagree with the statement. There is also a statistically significant difference regarding the statement that robotic applications can make the content of mathematics more concrete.

Nearly 50% of future pedagogical specialists fully agree with this, compared to 22% of practicing teachers ($\chi^2(4) = 12.394$; $p = .015$). 38% of future teachers fully agree to apply robotic applications in their future practice, while 60% of current teachers are not willing to use this innovative approach in the educational environment ($\chi^2(2) = 8.215$; $p = .016$). 22% of pedagogical students are willing to apply robotic applications in primary school mathematics lessons, compared to 75% of current teachers who would not use this approach in mathematics education ($\chi^2(2) = 11.579$; $p = .003$). Similar results were found regarding the effectiveness of this approach in education: 27% of future teachers agree that it is effective, compared to 72% of practicing teachers who believe it will not be effectively applied in the mathematics educational process ($\chi^2 (4) = 16.888$; $p < .000$).

Table 1.
Results of the Chi-square (χ^2), Analysis of Attitudes Towards the Introduction and Application of Robotic Applications in the Mathematics Educational Process.

Chi-square Analysis			**Makes mathematical tasks more meaningful for the student**				
$\chi^2(4)= 12.443$; p= 0.014			Strongly Disagree	Disagree	Moderately agree	Agree	Strongly Agree
Statement	Current teachers	%	2%	17,6%	33,3%	33,3%	13,7%
	Future teachers	%	3,6%	3,6%	20%	36,4%	36,4%
$\chi^2(4)= 16.044$; p= 0.003			**Improves students' thinking skills**				
			Strongly Disagree	Несъгласен	Moderately agree	Съгласен	Напълно съгласен
Statement	Current teachers	%	2%	15,7%	25,5%	39,2%	17,6%
	Future teachers	%	1,8%	5,5%	21,8%	18,2%	52,7%
$\chi^2(4)= 12.394$; p= 0.015			**Can make the mathematics material more concrete**				
			Strongly Disagree	Несъгласен	Moderately agree	Съгласен	Напълно съгласен
Statement	Current teachers	%	0%	9,8%	35,3%	33,3%	21,6%
	Future teachers	%	3,6%	5,5%	16,4%	25,5%	49,1%

Table 2.
Results of Chi-Square (χ^2), Analysis on Attitudes Towards the Integration and Application of Robotic Applications in Mathematics Education.

Chi-square Analysis		%	%	%
$\chi^2(4)= 14.677$; p= 0.001		**Disagree**	**Agree**	**Strongly Agree**
Status	Current teachers	43,1%	39,2%	17,6%
	Future teachers	29,1%	18,2%	52,9%

Nearly 53% of future teachers agree completely that robotic applications will effectively influence the negative attitudes some students have toward mathematics, making it a more attractive subject, compared to practicing teachers. Only 17.6% of practicing teachers fully agree with this statement, while 43% disagree with it ($\chi^2(4) = 14.677$; $p = .001$).

Discussion

The results of the study reveal clear differences in the attitudes of practicing and future teachers regarding the integration of robotic applications in mathematics education at the primary school level.

Firstly, the high level of anxiety, distress, among students in mathematics classes (80% of respondents) corresponds with previous studies that emphasize that math anxiety is a common phenomenon in primary education (Luttenberger et al., 2018; Passolunghi, 2016). This highlights the need for innovative approaches to reduce these negative emotional states and make mathematics education more accessible and engaging for students (Chen et al., 2023).

An interesting trend is the higher degree of acceptance of robotic applications among future teachers compared to practicing teachers. These results can be explained by the fact that future teachers are more open to technology and are trained in an environment that encourages the use of innovative methods. At the same time, practicing teachers may face limitations related to a lack of resources, time, or training to integrate such technologies into teaching. A similar difference is observed in attitudes regarding the impact of robotic applications on students' cognitive development. Future teachers are more likely to agree with the benefits of robotic applications on students' cognitive development. This suggests that the integration of robotic applications requires targeted training and support for current teachers so that they can effectively assess and apply these technologies.

Another significant result is the difference in opinion regarding the effectiveness of robotic applications in making mathematics content more concrete. A larger percentage of future teachers fully believe that these technologies will make mathematical concepts clearer and more accessible, compared to practicing teachers. This may be due to the fact that future teachers rely more on theoretical models for innovative teaching, while practicing teachers face real challenges when implementing new technologies, such as a lack of time, insufficient resources, or resistance to change. The results also show that a significant portion of practicing teachers are unwilling to apply robotic applications in their practice, while future teachers express readiness to do so. A similar trend is observed in opinions about the effectiveness of the approach – 72% of practicing teachers believe this method will not be effective, while 27% of students are confident in its

benefit. This emphasizes the need for targeted training and support for practicing teachers to reduce their reservations and facilitate their adaptation to new technologies.

Finally, a significant difference is evident in expectations regarding the impact of robotic applications on student motivation. A larger percentage of future teachers believe that they will make mathematics more attractive, while only 17.6% of practicing teachers share this view. This suggests that future teachers see robotic technologies as an opportunity to improve student engagement and interest, while current teachers likely fear the challenges associated with applying such innovations in a real classroom environment.

Future teachers demonstrate a higher degree of acceptance and optimism toward innovative technologies. Practicing teachers show more reservation, distrust, and uncertainty. These results suggest the need for targeted training and supportive policies to facilitate the integration of new technologies into the educational system. Only by providing adequate resources, training, and support can teachers fully harness the potential of robotic applications to enhance mathematics education and reduce student anxiety.

Limitations

This study presents only one part of the results related to the attitudes of actively engaged teachers in Bulgarian schools and trainees in this field regarding the integration and application of robotic applications in the educational sphere of mathematics. As part of the project, further research and interviews will be conducted with primary school students to complement the database regarding attitudes toward robotic applications and their impact on the educational process. Future significant results are expected to be published, fully covering the practical and applied field of the teaching profession, and potentially related to other professional fields.

Conclusion

To minimize the negative effects of multifaceted and complex psychological phenomena in the educational environment, it is essential to create conditions that support psycho-social well-being in both schools and families, as the fundamental institutions in personality development. The integration of robotic applications is an innovative pedagogical approach that enriches the learning process while maintaining a positive and stimulating educational environment. The use of robots as a tool in mathematics teaching for children aged 7-10 not only facilitates the understanding of abstract mathematical concepts but also provides them with opportunities for active participation in hands-on learning, social interactions, and creative projects.

These activities stimulate not only intellectual growth but also the development of skills to cope with stress and anxiety, increasing self-confidence and emotional resilience. By applying concepts in a fun and innovative way, a strong foundation for a successful transition into adulthood is laid, preparing children to face life's challenges.

Funding/Financial Support

The author has no funding to report.

Other Support/Acknowledgement

This study was done with the support of the Erasmus+ programme of the European Union, project name Anxiety Free Mathematics Education with Robotic Applications in Blended Learning, 2023-1-LV01-KA220-HED-000153826. The European Commission support for the production of this publication does not constitute an endorsement of the contents that reflects the views only of the authors, and the Commission cannot be held responsible for any use that may be made of the information contained therein.

Competing Interests

The author has declared that no competing interests exist.

References

American Psychological Association (APA). (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Arlington, VA: American Psychiatric Publishing.

Aro, T. (2020). *Stress in school children: Sources and consequences*. Journal of Child Development, 45(2), 150-167.

Baroody, A. J. (2006). *Why Children Have Difficulties Mastering the Basic Number Combinations and How to Help Them.* Teaching Children Mathematics, 13(1), 22–31;

Beck, A. T. (2000). *Kognitivna terapiya i emotsionalni razstroistva*. [Cognitive therapy and emotional disorders]. Publishing House Iztok-Zapad.

Bers, M., (2018). *Coding as a Playground: Programming and Computational Thinking in the Early Childhood Classroom.* Routledge.

Boaler, J. (2016). *Mathematical Mindsets: Unleashing Students' Potential through Creative Math, Inspiring Messages and Innovative Teaching.* Jossey-Bass.

Bowers, A. (2019). *Social stressors in childhood: A review of research on school bullying and peer relationships*. Child Psychology Review, 22(4), 312-328.

Chen, M. Y. K., Jamaludin, A., & Tan, A. L. (2023). Behavioural predictors of math anxiety. *arXiv preprint arXiv:2301.13639*.

Duma, S., Muslimin, Modjo, A., & Walid, A. (2024). The role of Mathematics Education in Developing Critical Thingking Skill in the Industrial Era 5.0. Aksioma *Education Journal, 1*, 1-10. https://doi.org/10.62872/rca4py44

Erikson, E. (2013). *Identichnost: mladost i kriza*. [Identity: youth and crisis]. Publishing House Riva.

Fredricks, J. A., & Eccles, J. S. (2006). Is extracurricular participation associated with beneficial outcomes? *Developmental Psychology, 42*(4), 698-713.

Fuchs, L. S., Geary, D. C., Compton, D. L., Fuchs, D., & Salthouse, T. A. (2010). *The contributions of numeracy and executive function to students' mathematical achievement*. *Journal of Educational Psychology, 102*(2), 486–500. https://doi.org/10.1037/a0018538

Geary, D. C. (2013). *Early Foundations for Mathematics Learning and Their Relations to Learning Disabilities.* Current Directions in Psychological Science, 22(*1*), 23–27. https://doi.org/10.1177/0963721412469398

Kaitera, S., & Harmoinen, S. (2022). Developing mathematical problem-solving skills in primary school by using visual representations on heuristics. *LUMAT: International Journal on Math, Science and Technology Education*, *10*(2), 111–146. https://doi.org/10.31129/LUMAT.10.2.1696

Jordan, N. C., Kaplan, D., Ramineni, C., & Locuniak, M. N. (2003). Early predictors of mathematics achievement and disability. *Developmental Psychology, 39*(3), 450–462. https://doi.org/10.1037/0012-1649.39.3.450

Kilpatrick, J., Swafford, J., & Findell, B. (Eds.). (2001). *Adding It Up: Helping Children Learn Mathematics.* National Academy Press.

Koen, L. (2015). *Sreshtu bezpokoistvoto*. Igroviyat roditelski podhod kam trevogite i strahovete v detskata vazrast. [Against anxiety. The play-based parental approach to worries and fears in childhood]. Publishing House Siela.

Lazarova, P. (2022). *Psihologiya na razvitieto. Vazrastova psihologiya.* [Developmental psychology. Age psychology]. Publishing House Episkop Konstantin Preslavski.

Levin, P. (2023). *S bezmalven glas.* [With a silent voice] Publishing House Iztok-Zapad.

Luttenberger S, Wimmer S, & Paechter (2018). M. Spotlight on math anxiety. *Psychol Res Behav Manag. 11*, 311-322. https://doi.org/10.2147/PRBM

Mian, N. D., Godoy, L., & Franz, L. (2012). *Understanding the impact of parental anxiety on child anxiety.* In P. J. Cooper & M. Creswell (Eds.), Overcoming Your Child's Fears and Worries: A Self-help Guide Using Cognitive Behavioral Techniques, Constable & Robinson;

Mix, K. S., & Cheng, Y. L. (2012). *The relation between space and math: Developmental and educational implications.* Advances in Child Development and Behavior, 42, 197–243. https://doi.org/10.1016/B978-0-12-394388-0.00006-X;

Nelson, J. M., & Leung, J. A. (2019). *The role of emotional regulation and anxiety in academic performance during early childhood education*. *Early Childhood Research Quarterly, 48*, 230-242. https://doi.org/10.1016/j.ecresq.2018.12.003

Paaskesen, R. (2020). Play-based strategies and using robot technologies across the curriculum. *International Journal of Play. 9*. 1-25. https://doi.org/10.1080/21594937.2020.1778272

Papancheva, R., & Dermendzhieva, L. (2021). Stem in education – workshop for resources and ideas. Education and Technologies Journal, 12, 229-235. https://doi.org/10.26883/2010.211.3248

Passolunghi, M.C, Caviola, S., de Agostini, R., Perin, C., Mammarella, I.C. (2016). Mathematics anxiety, working memory, and mathematics performance in secondary-school children. Frontiers in Psychology, 7(42) https://doi.org/10.3389/fpsyg.2016.00042

Pianta, R. C. (1999). *Enhancing relationships between children and teachers.* American Psychological Association.

Rahmatika, M. & Hernawati, N. (2016). The Influence of School Environment, Social Intelligence, and Self-Esteem toward Academic Achievement of Student in Rural Area*. Journal of Child Development Studies. 1*, 27. https://doi.org/10.29244/jcds.1.01.27-38.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68

Singer-Freeman, K.E. (2005). "Concrete Operational Period". *Encyclopedia of Human Development*. *1*. doi:10.4135/9781412952484.n148

Sullivan, A., & Habib, M. (2020). The role of teacher-student relationships in children's academic and emotional development. *Frontiers in Psychology, 11*, 1–12. https://doi.org/10.3389/fpsyg.2020.00359

Topalska, R. (2021). STEAM Education in the View of the Bulgarian Teacher. *TEM Journal, 10(*4), 1822-1827 https://doi.org/10.18421/TEM104-45

van Oers, B. (2024). The Development of Mathematical Thinking in Young Children's Play: The Role of Communicative Tools. In: Palmér, H., Björklund, C., Reikerås, E., Elofsson, J. (eds) *Teaching Mathematics as to be Meaningful – Foregrounding Play and Children's Perspectives.* Springer, Cham. https://doi.org/10.1007/978-3-031-37663-4_1

Weems, C. F., Hayward, C., & Killian, M. (2008). *Childhood anxiety and trauma: A review of the literature and implications for treatment*. *Psychiatric Clinics of North America, 31*(3), 495-516. https://doi.org/10.1016/j.psc.2008.03.004;

Wigfield, A., & Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology, 25*(1), 68–81. https://doi.org/10.1006/ceps.1999.1015

Zhelyazkova, M. (2023). STE(A)M EDUCATION CHALLENGES IN BULGARIA. *KNOWLEDGE – International Journal 56.2*, 169-173.

Zimmer-Gembeck, M. J., & Skinner, E. A. (2011). *The development of coping across childhood and adolescence: An integrative review and critique of research. International Journal of Behavioral Development, 35*(1), 1–17. https://doi.org/10.1177/0165025410384934

About the Authors

Elena Karashtranova is an Associate Professor in the Department of Informatics and the Dean of the Faculty of Natural Sciences and Mathematics at South-West University "Neofit Rilski" in Blagoevgrad. Her research interests include Mathematics and Informatics Teaching Methodology, Applied Statistics, Natural Language Processing, and Data Mining.

Corresponding Author's Contact Address[TOP]

Department of Informatics
South-West University "Neofit Rilski"
66 Ivan Mihaylov str.
2700 Blagoevgrad, Bulgaria
Email: helen@swu.bg