APPLICATION OF THE PROGRAMMABLE DEVICE BEE-BOT IN PHYSICAL EDUCATION AND SPORTS CLASSES

Radoslava Topalska
South-west University 'Neofit Rilski', Blagoevgrad, Bulgaria, topalska@swu.bg

Abstract: The presented material examines the possibilities of integrating programmable devices, specifically Bee-Bot, into physical education games in the early stages of primary education. The main idea is that the robot should not only be used as a tool for first steps in programming, but should be incorporated into a broader educational context in which movement, play, and technology interact. In this way, physical education classes are enriched with a modern element that is attractive to students, without disrupting their main function – the development of motor skills and the formation of a need for movement.

The active games described in the project are aimed at developing basic motor skills – speed, endurance, strength, coordination, balance – but also at maintaining attention, quick reactions, and self-control. In many situations, students must adapt to changes set by Bee-Bot, such as the beginning and end of an action, changing tasks or directions, and different roles. This stimulates adaptability and the ability to orient oneself in a changing play environment. At the same time, the natural motivation to play that is typical for this age is preserved – students perceive the lessons as fun and varied, rather than a mechanical repetition of exercises.

The potential for interdisciplinary integration is also clearly evident. By including letters, numbers, colours, geographical or thematic "cards," animals, and other symbols, physical education is linked to educational content from various subject areas – Bulgarian language, mathematics, the surrounding world, visual arts, and music. The student is placed in a situation where he/she must simultaneously move, think, observe, and make simple choices or decisions. In this way, memorization and practice of knowledge take place in motion, and not just at the desk, which is especially valuable for younger students who learn more easily through action.

The social aspect is also evident. Some of the games involve working in pairs, small groups, or teams. This helps develop skills for cooperation, following rules, and respecting the order and role of others. Students get used to waiting for their turn, working with the group, and accepting both success and failure in a game situation.

From a methodological point of view, the use of a programmable device in physical education classes also has a purely practical advantage: some of the teacher's verbal instructions are "transferred" to the robot. The teacher sets predefined routes, commands, or symbols, and during the game, they can observe and assist the students instead of constantly giving commands. This can facilitate group management, especially in larger classes, and allow for more accurate monitoring of the behaviour and participation of individual children.

Overall, the study demonstrates that integrating Bee-Bot and similar programmable devices into moving games is a realistic and applicable approach for modern physical education classes. This lays the foundation for future research and practices aimed at integrating STEAM elements into physical education and the overall development of students by combining play, movement, and modern educational technologies.

Keywords: programmable devices, technologies, physical education and sports, outdoor games

1. INTRODUCTION

In recent years, the introduction of programmable devices and educational robotics in primary and pre-school education has been increasingly seen as a means of increasing motivation, developing programming skills, and developing key competencies. Empirical studies in Bulgaria and internationally show that practical robotics classes engage students in a different way than traditional lessons. It is no coincidence that authors working in the STEM context emphasize that "Students enjoy this type of practical activity, which increases their interest and motivation and enables them to complete practical tasks." (Mihov et al., 2022). Similar results show that the practical and applied nature of robotics classes supports not only the acquisition of content, but also the completion of tasks. Taken together, these findings suggest that robotics should be viewed not as a peripheral innovation, but as a structurally significant element of contemporary educational practice.

Bee-Bot programmable robots are particularly suitable for preschoolers because they combine play with the early development of computational thinking. The conclusion that "The use of Bee-Bot in preschool groups proves to be an effective method for introducing the concepts of computational thinking in a playful and accessible way" is indicative. (Gamarra-Expósito et al., 2025). Here, the game context is not just an external "decoration" of the lesson, but a key didactic tool – children learn sequences, algorithmic thinking, and cause-and-effect relationships precisely through motor and spatially oriented play. In this way, Bee-Bot functions as a bridge between spontaneous children's play and an intentionally organized learning activity.

Similar results are reported when using visual programming environments such as Scratch. After examining the role of tangible robots like Bee-Bot, it is logical to turn to software-based tools that offer similar pedagogical advantages. For younger students, the first question is whether programming will be interesting and accessible to them. The data show that "These results clearly show that all students enjoyed the lessons to a very large extent." (Wilson & Moffat, 2010). In other words, introducing programming through an interactive environment similar to a game changes the emotional background of learning – students do not perceive the tasks as "dry" code learning, but as a creative activity. This is also confirmed by more recent studies: "Research shows that using Scratch improves students' computational thinking, creativity, and understanding of programming." (Fitria, 2025). In this sense, Scratch and similar tools can be seen as a kind of "programmable resource" that simultaneously develops thinking and meets the need for play and creativity. Thus, both physical robots and virtual environments rely on the same pedagogical mechanism: learning emerges through exploration, experimentation, and playful problem-solving.

When robotics and programmable devices are systematically introduced in primary school, the effects are not limited to motivation and individual skills. Several studies show a significant contribution to social and communication skills. For example, a meta-analysis on educational robotics for children emphasizes that "The results show that robots can most strongly improve cooperation among young students and contribute to their communication skills" (Sapounidis et al., 2025). In a similar vein, another study in a kindergarten talks about "...the impact of educational robotics activities on kindergarten children in mastering computational thinking and programming skills" (Muñoz-Repiso & Caballero-González, 2019). Here, the emphasis is twofold: on the one hand, robotics helps master computational thinking, and on the other, it structures an environment in which students must discuss, plan, and coordinate their actions. Consequently, educational robotics can be interpreted as a context in which cognitive and social learning processes are tightly intertwined.

This collaborative aspect is also highlighted in a study focused on working with programmable robots in kindergarten: "They also agree that the activities carried out using this technology enable student inclusion and the development of collaborative learning." (Caballero-González & García-Valcárcel Muñoz-Repiso, 2017). In this case, programmable devices are seen not just as technology but as a means of collaborative learning and an inclusive classroom environment. At the macro level, this is also confirmed by review articles: "Due to the potential benefits it offers for teaching students at all levels, educational robotics has established itself as an effective pedagogical tool." (Gavrilas, 2024). Bibliometric analyses also show that it "...demonstrates how the integration of robotics into primary school classrooms can support the overall growth and development of students." (Martínez Rojas et al., 2025). Thus, educational robotics is linked to overall development – cognitive, social, and emotional. This broad spectrum of effects justifies the growing interest of researchers and practitioners in integrating robots into everyday classroom routines.

The question of specific devices entering preschool and primary education is also important. Among the most commonly studied is Bee-Bot: "Bee-Bot is a small, programmable robot designed primarily for educational purposes and aimed at teaching young children basic coding and sequencing skills through interactive play." (Paraskevopoulou-Kollia et al., 2025). This definition clearly shows how a compact resource combines educational goals (basic coding and sequencing skills) with game accessibility. In the context of interdisciplinary projects, robotics also fits into the STEAM framework, such as in the "Sustainable City" project, where it is noted that "...the results were better on the follow-up test, indicating that students improved their skills and increased their motivation." (Ruiz Vicente et al., 2020). This shows that robotics is not an "add-on" but an integral part of instructional design that influences both knowledge and attitudes. In other words, when robotics is embedded in meaningful project-based tasks, it supports not only isolated technical skills but also broader educational objectives.

The accumulated data is summarized at the meta-analysis level. A multi-stage study on the effects of educational robotics in STEM education emphasizes that "The present study finds a moderate and positive effect ($g = 0.488$) of educational robotics on students' STEM learning." (Ouyang & Xu, 2024). This provides a quantitative measure of the claim that robotics actually improves results and is not just an "attractive" form of work. Such quantitative evidence is particularly important for educational decision-makers, as it legitimizes the inclusion of robotics in curricula on an evidence-based basis.

In addition to classic robots, mini-computers such as the BBC micro:bit are increasingly being used in primary education. A systematic review indicates that "The results show that the BBC micro:bit facilitates the development of computational thinking, creativity, problem-solving skills, and collaboration abilities in students, while also supporting their autonomy." (Papadaki, 2025). Thus, micro:bit proves to be a platform that supports both individual and collective aspects of learning in a unified format. Another study adds further emphasis: "Another benefit of this mini-computer is learning the basics of robotics." (Stanojević et al., 2021). This means that micro:bit is a kind of bridge between abstract programming and real robotic systems. Accordingly, the ecosystem of educational

technologies in the classroom is expanding – from simple robots to versatile microcomputers that can control various devices and sensors.

Robotics also has a place in mathematics education, where educational robots are considered a key teaching resource: "Educational robots allow students to enter this new technological world, and they are also one of the best teaching tools." (Muñoz et al., 2020). Following long-term initiatives in primary schools, authors with almost ten years of experience in educational robotics conclude that "Robot programming education is an opportunity for primary school students to develop their language and logical skills." (Valzano et al., 2021). Thus, robotics goes beyond the narrow STEM focus and is also linked to language and logical competencies. This cross-curricular impact confirms that robotics can serve as a unifying platform for integrating different subject areas around common problem-solving activities.

Specifically, for Bee-Bot and its digital extensions (simulators), a direct link with motivation and computational thinking is shown: "The results showed significantly higher learning motivation among students, which means that the various learning activities using the Bee-Bot simulator had a positive impact on different sub-dimensions." (Choi et al., 2024). This result complements previous claims about the playful nature of robotics and shows that well-designed learning activities with programmable devices can simultaneously influence students' motivation, cognitive skills, and social interaction. Therefore, Bee-Bot can be seen as a particularly suitable tool when the teacher aims to combine engagement, movement, and the introduction of algorithmic logic at an early age.

Interactive teaching methods and moving games are becoming increasingly central to modern physical education, as they combine physical activity, social interaction, and personal development. In this context, play is seen not simply as entertainment, but as a pedagogical tool with clear educational and training potential. It is no coincidence that "play, as a form of simulation, is widely used in physical education and sports classes" (Rumenov, 2018). Within this approach, emphasis is placed on its multifaceted effects: "Play encourages communication; increases students' interest in learning; develops student autonomy and introduces them to the role of activity" (Rumenov, 2018). At the same time, it is noted that "the use of this method will help develop self-regulation, self-control, and self-assessment in students" (Rumenov, 2018). Thus, the logic of play-based learning, already highlighted in the context of robotics, finds a natural continuation in the organization of physical education classes.

Movement and sports preparation games are also directly relevant to the acquisition of sports skills. In the Bulgarian context, it is pointed out that "their applicability would have a positive effect on both motor activity and the consolidation of lasting knowledge and skills for the types of sports" (Rumenov, 2025) This conclusion clearly links the playful approach to the effectiveness of the physical education and sports learning process, emphasizing that play not only increases activity but also leads to a deeper and more lasting acquisition of learning content. From this perspective, the integration of new technological tools into such games appears as a logical next step in enriching the traditional methodological arsenal.

The importance of outdoor games in preschool age is particularly evident. According to Shabanski, "outdoor games are an effective means of comprehensive personal development, as useful habits and movements are acquired naturally, in the form of play" (Shabanski, 2015). In this sense, play provides a natural environment for development in which children move, learn, and communicate without feeling the pressure characteristic of more formal forms of education. In addition, it is emphasized that "good mood is an essential element of play and has a positive effect on the nervous system of the growing organism" (Shabanski, 2015). Thus, active play is not only a means of physical but also mental strengthening. The educational potential is also evident on a moral level: "Active games cultivate moral qualities. Children learn to live in a group and to obey common rules" (Shabanski, 2015). These three emphases – comprehensive development, emotional comfort, and moral education – define active play as a complex pedagogical tool in early childhood. This multifaceted impact of play creates a favorable background for the meaningful integration of programmable devices into movement-based activities.

International authors also emphasize the importance of active and traditional games for children's health and development. Binjoš points out that "play is particularly important for the health and physical development of the child." In the context of preschool physical education, he adds that "motor play is considered a key form of activity in physical education for preschool children, where movement is a prerequisite for physical development." This positions it as a leading method through which a targeted impact on the motor system is achieved. In addition, its versatility is also emphasized: "motor play is versatile because the child learns coordination routinely and with ease, paying attention to when to run, when to stop, when to bend over" (Binjoš, 2011). It is through these natural repetitions in the form of play that children develop fundamental motor skills and coordination. Hence, movement games can be seen as a natural "arena" in which additional educational elements – such as computational thinking – can be gradually introduced.

Traditional games are considered particularly useful in the physical education learning process. A systematic review notes that "traditional games are an effective tool in supporting the physical education learning process in school"

(Wicahyani, 2025). The authors emphasize not only their didactic function, but also their developmental function: "there are many benefits of traditional games that influence the improvement of learning outcomes, including cognitive, affective, and psychomotor aspects" (Wicahyani, 2025). This shows that traditional outdoor games can be used purposefully to develop not only physical abilities but also cognitive and emotional skills. In this sense, traditional games and modern technological tools should not be seen as competitors, but as complementary resources in the teacher's toolkit.

Bulgarian studies complement the picture by focusing on specific effects. Alexiev notes that "the physical exercises involved in active games contribute to the physical and mental strengthening of children" (Alexiev, 2008). In the same study, he also emphasizes their strong social and communicative impact: "active games provide opportunities for communication between children, shape their personalities, and have a strong impact on their speech activity" (Alexiev, 2008). Here we can see how outdoor games become a field for linguistic, social, and personal development, rather than just a means of "burning off energy." This aligns with the previously cited conclusions about the social benefits of educational robotics, reinforcing the idea that movement, communication, and cooperation are central components of effective learning environments.

At the level of pedagogical organization, Yaneva-Prokopova emphasizes that "active games are one of the most appropriate tools in everyday kindergarten life that contribute to increasing children's motor activity" (Yaneva-Prokopova, 2019). This statement fits into the broader context of the search for contemporary, non-traditional forms that make physical education and sports classes more attractive to children. In this sense, Dimitrova notes that "a variety of non-traditional forms and means are presented, including moving games with contemporary themes, which not only promote physical activity" (Dimitrova, 2024). She adds that "modern non-traditional forms and means increase interest and motivation, thus contributing to the acquisition of healthy habits throughout life" (Dimitrova, 2024). Here, moving games fit into a broader pedagogical model of healthy lifestyles and long-term behavioral changes. It is precisely in this field of non-traditional and mobile forms that the integration of programmable devices such as Bee-Bot into physical education becomes particularly meaningful.

New systematic reviews and literature analyses confirm that traditional outdoor games have significant health benefits. Ismoyo and co-authors point out that "physically, traditional games help improve physical fitness, coordination, and motor skills." Mentally, "these activities can reduce stress, improve concentration, and promote happiness and well-being" (Ismoyo, 2024). Another review emphasizes that "several studies show that traditional games have a significant positive effect on students' physical fitness" (Muhaimin, 2024). The same authors add that "physical activities based on traditional games significantly improved the psychological well-being of primary school students by helping to reduce anxiety, increase confidence, and promote happiness" (Muhaimin, 2024). This shows that traditional games have a dual effect on both the physical and mental spheres. The dual (physical and psychological) benefit of games resonates with the holistic educational goals pursued in contemporary curricula.

In a narrower educational context, Purnama and co-authors conclude that "the results of the study suggest that physical education, health, and sports training using traditional games can improve learning outcomes related to physical fitness" (Purnama, 2024). This finding confirms that integrating traditional games into the learning process not only makes lessons more interesting, but also leads to tangible improvements in achievement. In summary, Hassani emphasizes that "these games can improve fundamental motor skills, motor competence, as well as coordination and interaction abilities between individuals" (Hassani, 2024).

Summarizing these results, it can be concluded that active and traditional games – both in kindergarten and elementary school – have a proven contribution to the physical, mental, social, and cognitive development of children, and their systematic application in physical education classes is a scientifically sound and pedagogically effective practice. Against this backdrop, the question arises of how modern programmable devices can be meaningfully integrated into these already established forms of movement-based learning.

2. METHODOLOGY: GAME SCENARIOS WITH BEE-BOT IN PHYSICAL EDUCATION CLASSES

The examples of moving games with Bee-Bot presented here show how programmable devices can be integrated into physical education classes, combining physical activity, play, and elements of computational thinking. In these games, Bee-Bot successively becomes a "traffic light," a signal, a guide, a teacher, a conductor, or a referee, and students perform various motor, coordination, and cognitive tasks according to its movements, sound, or position on the playing field. Each scenario illustrates a specific way in which the robot can take on a role familiar from children's games and thereby enrich it with an additional layer of meaning and structure.

In the game "**Red-Green**," Bee-Bot is used as a kind of traffic light: when the robot moves forward, it means "green" and the students run, and when it stops, it means "red" and they must stop in place. This simple command logic trains reaction, attention, and movement control. The game is suitable for students in grades 1 to 3 and requires the use of a Bee-Bot robot and coloured cards to indicate the signals.

In "**Find Your Home**," Bee-Bot becomes a mediator between image and action: the robot stops on a card with a given animal, and the children playing the role of that animal must quickly run to their hoop – their "home." This develops spatial orientation, speed, and observation skills. The game is designed for grades 1–4 and is played with the help of Bee-Bot, themed animal cards, and hoops placed in the stadium or yard.

In the game "**Hot Potato**," Bee-Bot regulates the time of execution. While the robot is moving, the students in a circle pass a ball – the "hot potato" – to each other. The moment Bee-Bot stops, the child holding the ball performs a pre-set exercise (e.g., squats, jumps, balance). This trains coordination and attention, as well as the ability to react quickly to a change in signal. The game is designed for children in grades 2 to 4 and requires Bee-Bot and a suitable ball.

In the game "**Sea Chess**," Bee-Bot helps introduce the basics of strategy and spatial thinking. The robot moves around a large grid on the floor and stops at different cells, which students mark with their symbols. The objectives here are focused on spatial orientation, planning, and strategy. The game is for 3rd and 4th grade students and requires the Bee-Bot app, a grid field, and cones/caps or other markers to mark the moves.

"**Colors, Stop**!" is a game for the youngest children, in which the Bee-Bot stops on different colored cards. Students must quickly find an object in the classroom that is the same color. This trains color recognition, reaction, and quick orientation. The game is suitable for children in grades 1–2 and is played with Bee-Bot and a set of coloured cards and various objects.

In "**Blind Old Woman**," Bee-Bot acts as an audio guide. A child with their eyes blindfolded (with a scarf) must find the robot in the space, guided solely by the sound it makes. This exercise develops orientation and confidence in movement without visual support. It is suitable for grades 1–4 and requires a Bee-Bot and a scarf for blindfolding.

In "**Collect the Treasure**," Bee-Bot stops on a card with a symbol, and students must find a specific object in the room that corresponds to that symbol. The game develops speed, orientation, and the ability to search according to specified criteria. It is aimed at students in grades 1–3 and requires Bee-Bot, symbol cards, and objects ("treasures") placed around the room.

The game "**Relay**" integrates Bee-Bot as a guide within the selected route. The robot sets a route that students must follow in relay form – in pairs or teams. This encourages teamwork, speed, and coordination in motion. It is suitable for grades 2–3 and is played with Bee-Bot and cones to mark the route.

In "**Dance Figures**," Bee-Bot dictates the movements – the robot stops on cards with different movement commands (squat, jump, spin, clap, etc.), and students perform the given figures in rhythm. The game trains rhythm, coordination, and following instructions. It is aimed at 2nd–3rd grade and requires Bee-Bot and a set of movement cards.

In "**Hunters and Deer**," Bee-Bot acts as a signal. When the robot makes a sound or performs a specific movement, the "deer" (one group of students) must run away, and the "hunters" chase them according to pre-set rules. The game develops quick reactions and strategy and is suitable for grades 3–4, using Bee-Bot and an open/marked field.

"**Hide if you can**" uses Bee-Bot as an "observer." Students move only when Bee-Bot has its "back turned" (i.e., facing the opposite direction), and when it turns toward them, they must freeze. This trains self-control and attention. The game is suitable for grades 1–3 and requires only Bee-Bot.

In the game "**Maze**," Bee-Bot shows the way through a pre-built maze of strips or cones, and students follow it physically. This exercise develops algorithmic thinking and spatial orientation, as children have to "translate" the programmed path into real movement. It is suitable for grades 2–4 and is conducted with Bee-Bot and strips/markers for the maze.

"**Bee Courier**" presents Bee-Bot as a message carrier. The robot stops at a specific student, who must run to a target point and return. The game develops orientation and endurance and is suitable for grades 1-4, requiring Bee-Bot and cards for setting the "address."

In "**Step Counter**," Bee-Bot sets the pace of movement. Students must take the same number of steps as the robot has taken. This trains control and counting skills. The game is suitable for grades 1–2 and requires only Bee-Bot.

In "**Teacher Bee**," Bee-Bot acts as an exercise instructor – it stops on a card with a specific exercise, and students perform it for a set amount of time. This encourages self-control and repetition of the movement. The game is suitable for grades 1–2 and uses Bee-Bot and exercise cards.

"**Point Counter**" turns Bee-Bot into a referee: the robot sets the time for different exercises, and students collect points according to the number of correctly performed repetitions. This trains endurance and attention. The game is for grades 3-4 and requires Bee-Bot and a scoreboard.

The ideas for games with Bee-Bot described above show a wide range of possibilities for integrating programmable devices into physical education classes – from developing basic motor skills and attention to forming algorithmic thinking, language skills, and cultural awareness, all in highly playful formats that motivate students.

3. RESULTS AND DISCUSSION

The presented report outlines a conceptual and practical framework for integrating the Bee-Bot programmable device into moving games in physical education classes at the primary level. Based on the analyzed literature and the proposed game scenarios, it is confirmed that robotic and programmable tools can be an organic part of the learning process without disrupting the main objective of the subject – the development of motor skills and the formation of a need for movement – but rather reinforcing it.

The results of the studies reviewed show that educational robotics and visual programming environments (including Bee-Bot, Scratch, micro:bit, etc.) increase motivation to participate in classes, contribute to the development of computational thinking, creativity, and problem-solving skills, as well as the development of collaboration and communication skills. In this context, Bee-Bot can be seen as a "programmable resource" that simultaneously engages students in play and movement and introduces them to the basic principles of algorithmic thinking and programming.

The ideas for moving games with Bee-Bot described in the report demonstrate how, within a single lesson, work on speed, endurance, strength, coordination, and balance can be combined with training in attention, self-control, quick reactions, and orientation in a changing play environment. Through the use of letters, numbers, colours, geographical maps, symbols and roles, interdisciplinary integration with Bulgarian language, mathematics, "The World Around Us", art and music is achieved. In this way, knowledge is "experienced" in motion, which is particularly important for younger students who tend to learn more easily through action than through static work at their desks.

A particularly important aspect is the social and educational potential of the proposed games. Working in pairs, small groups, or teams helps develop skills for cooperation, following rules, accepting the roles of others, and coping with success and failure in a game situation. At the same time, part of the teacher's instructions are "transferred" to Bee-Bot, which facilitates classroom management and allows the teacher to observe the involvement and behaviour of individual students more closely.

4. CONCLUSION

In summary, it can be concluded that the application of Bee-Bot in moving games is a realistic, methodologically sound, and promising approach to contemporary physical education and sports training in primary school. It allows for maintaining high motor activity, integrating elements of STEAM education, and supporting the overall physical, cognitive, social, and emotional development of students. This opens up opportunities for future research aimed at empirically evaluating the effects of such integrated models and developing additional game scenarios and methodological solutions for different age groups and educational contexts.

REFERENCES

Alexiev, R. (2008). Rolyata na podvizhnite igri za stimulirane na rechevata aktivnost na detsata [The role of movement games for stimulating children's speech activity]. *Nauchni trudove na Rusenskiya universitet*, 47(5.4), 173–175.

Binjoš, H. (2011). Movement games and body exercises in preschool institutions. *Activities in Physical Education & Sport*, 1(1), 75–78. https://fsprm.mk/wp-content/uploads/2022/03/Pages-from-APES2011-Vol.1No.1-14.pdf

Caballero-González, Y. A., & García-Valcárcel Muñoz-Repiso, A. (2017). Development of computational thinking and collaborative learning in kindergarten using programmable educational robots: A teacher training experience. In J. M. Dodero, M. S. Ibarra Sáiz, & I. Ruiz Rube (Eds.), *Fifth International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'17)* (Article 5). ACM.

Choi, W. C., Choi, I. C., Lam, C. T., & Mendes, A. J. (2024). Learning sequencing with Bee-Bot: A study on improving computational thinking and motivation for young learners in programming education. In *2024 IEEE Frontiers in Education Conference (FIE 2024) – Proceedings*.

Dimitrova, Z. (2024). Non-traditional forms and means of physical education and sports education in kindergarten and primary school. *Knowledge – International Journal* (conference paper).

Fitria, T. N. (2025). Teaching coding using Scratch to elementary students: Exploration of benefits for students. *Journal of Contemporary Issues in Elementary Education*, 3(1), 1–17. https://doi.org/10.33830/jciee.v3i1.10719

Gamarra-Expósito, A., De-la-Fuente-Valentín, L., Gómez-Albarrán, M., & Crespo-García, R. (2025). Integrating programmable robots to foster computational thinking in early childhood education. *CEUR Workshop Proceedings*, 3997 (short paper). https://ceur-ws.org/Vol-3997/short1.pdf

Gavrilas, M. (2024). Exploration of the prospective utilization of educational robotics in primary school. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, 15(1), 350–369.

Hassani, F. (2024). Be more active with traditional games: Traditional review. *Türkiye Klinikleri Journal of Sports Sciences*, advance online publication.

Ismoyo, D., Nasrulloh, A., Hermawan, H. A., & Ihsan, F. (2024). Health benefits of traditional games – a systematic review. *Retos*, 59, 843–856. https://www.revistaretos.org/index.php/retos/article/view/107467

Martínez Rojas, E., Valencia-Arias, A., Vásquez Coronado, M. H., Barandiarán Gamarra, J. M., Agudelo-Ceballos, E., Benjumea-Arias, M. L., & Vega Mori, L. (2025). Educational robotics for primary education: An analysis of research trends. *Eurasia Journal of Mathematics, Science and Technology Education*, 21(3), em2602.

Mihov, T., Stoitsov, G., & Dimitrov, I. (2022). STEM robotics in primary school. *Mathematics and Informatics*, 65(2), 149–159. https://azbuki.bg/wp-content/uploads/2022/05/Matematika_02_Tsanko-Mihov.pdf

Muhaimin, M., Purnama, D., & Mardiah, N. (2024). The impact of traditional games on physical fitness and well-being of students: A literature review. *South Eastern European Journal of Public Health*, 22, Article 1751.

Muñoz, L., Villarreal, V., Morales, I., Gonzalez, J., & Nielsen, M. (2020). Developing an interactive environment through the teaching of mathematics with small robots. *Sensors*, 20(7), 1935.

Muñoz-Repiso, A. G. V., & Caballero-González, Y. A. (2019). Robotics to develop computational thinking in early childhood education. *Comunicar*, 27(59), 63–72.

Ouyang, F., & Xu, W. (2024). The effects of educational robotics in STEM education: A multilevel meta-analysis. *International Journal of STEM Education*, 11, Article 7.

Papadaki, E. (2025). The BBC micro:bit in primary schools: A systematic review on computational thinking, creativity, and pedagogical strategies. *Advances in Mobile Learning Educational Research*, 5(2), 1611–1620.

Paraskevopoulou-Kollia, E.-A., Stergiou, I., & Kalogiannakis, M. (2025). Computational thinking in primary and pre-school children: A systematic review. *Education Sciences*, 15(2), 985.

Purnama, D., Muhaimin, M., & Mardiah, N. (2024). The influence of traditional games and learning motivation to improve physical fitness learning outcome. *Jurnal Penelitian Pendidikan*, 24(2), 123–132.

Rumenov, Y. (2018). Interactive training methods and their implementation in the physical education and sport lessons from the field of (compulsory) curriculum content in athletics. *Activities in Physical Education and Sport*, 8(1–2), 37–39.

Rumenov, Y. (2025). Ekspertna otsenka na sportno-podgotvitelni igri i prilozhenieto im v uchebniya protses [Expert evaluation of sports-preparatory games and their application in the learning process]. *Knowledge – International Journal*, 71(5), 715–721.

Ruiz Vicente, F., Zapatera Llinares, A., & Montés Sánchez, N. (2020). "Sustainable City": A STEAM project using robotics to bring the city of the future to primary education students. *Sustainability*, 12(22), 9696.

Sapounidis, T., Rapti, S., & Vaiopoulou, J. (2025). Effects of educational robotics on kindergarteners' collaboration, communication, critical thinking, and creativity: A meta-analysis. *Journal of Science Education and Technology*, 34, 73–87. https://doi.org/10.1007/s10956-024-10149-1

Shabanski, F. (2015). Izpolzvane na podvizhnite igri za uvelichavane na fizicheskata aktivnost na decata v preduchilishtna vazrast [Use of games for increasing physical activity of pre-schoolers]. *Science & Technologies*, 5(8), 67–71. https://www.sustz.com/journal/0/1600.pdf

Stanojević, D., Rosić, A., Ranđelović, B., & Stanković, Ž. (2021). Micro: Bit as a tool for improvement of education. *International Journal of Management Science and Business Administration*, 7(2), 14–19.

Valzano, M., Vergine, C., Cesaretti, L., Screpanti, L., & Scaradozzi, D. (2021). Ten years of educational robotics in a primary school. In D. Scaradozzi et al. (Eds.), *Makers at School, Educational Robotics and Innovative Learning Environments* (Lecture Notes in Networks and Systems, Vol. 240). Springer.

Wicahyani, S., Williyanto, S., Muhammad, H. N., Hidayat, T., Wibowo, S., Prasetyo, A., & Andrijanto, D. (2025). The role of traditional games in the physical education learning process: A systematic review. In *Proceedings of the International Seminar of Sport and Exercise Science (ISSES 2024)* (pp. 65–75). Atlantis Press.

Wilson, A., & Moffat, D. C. (2010). Evaluating Scratch to introduce younger schoolchildren to programming. In *Proceedings of the 22nd Annual Workshop of the Psychology of Programming Interest Group (PPIG 2010)* (pp. 1–12). https://scratched.gse.harvard.edu/sites/default/files/wilson-moffat-ppig2010-final.pdf

Yaneva-Prokopova, A. (Ed.). (2019). *Savremenni tendentsii na fizicheskoto vazpitanie i sporta* [Contemporary trends of physical education and sport]. Sofia: Universitetsko izdatelstvo „Sv. Kliment Ohridski".