Bojan D. Miloradović
University of Kragujevac
Faculty of Education in Jagodina
PhD Student
Živorad M. Marković
Aleksandar M. Ignjatović
Department of Didactics and Methodology

УДК 37.013::796
DOI 10.46793/Uzdanica21.2.297M
Прегледни рад
Примљен: 28. јануар 2024.
Прихваћен: 21. јун 2024.

INTEGRATIVE APPROACH IN TEACHING PHYSICAL EDUCATION USING LOGICAL-MATHEMATICAL GAMES: A SYSTEMATIC REVIEW[1]

Abstract: Integrative approach in teaching implies the unification of the curriculum of different subjects, representing the natural, logical and practical connection of individual scientific disciplines. An integrative approach in the teaching of physical education using logical-mathematical games provides a wide range of possibilities in the implementation and organization of teaching, improving the quality of teaching that can respond to the needs of multitasking and modern life. In such a process students are motivated to work more successfully in order to acquire knowledge allowing them practical application of acquired knowledge. Also, students' critical thinking is stimulated and the time of active exercise increases, which stimulate students' cognitive development and has a positive effect on students' mathematical achievements. The methodology of selection of relevant papers was performed on the basis of searches in electronic databases, and those that contain elements of an integrative approach in the field of research were selected. Based on the analysis of the research, 51 publications were identified, and only 9 publications published in the past 20 years met the criteria of this paper. The need for more detailed research in this area is evident, both due to the insufficient number of researches and due to the examination of the effects of the integrative approach in teaching physical education on motor abilities and skills of the youngest students.

Key words: integrative approach, physical education, logical-mathematical games, mathematical achievement.

INTRODUCTION

As acquired knowledge is appreciated in real-life contexts, an integrative approach in teaching is increasingly current in modern education systems and provides opportunities for students to be more successful in dealing with emerging

[1] This research was partially funded by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Contract No. 451-03-65/2024-03/ 200140).

bojanucitelj@gmail.com

situations. An integrative approach in teaching, as a modern learning concept, enables the pooling of knowledge across different teaching areas.

The integrative approach in physical education teaching, pointing out the connection of scientific principles, refers to the meaningfully united curricula of different subjects. The direction of the work refers to the simultaneous development of motor abilities and skills, as well as critical thinking. By practicing and applying different knowledge in specific situations, the acquisition of functional knowledge is indicated. Referring to the Gestalt theory, according to which mental processes cannot be partialized into smaller parts, "physical education teaching implies the unity of influence on students in all segments of anthropological status in motor skills, functional, psychological, sociological and cognitive segments" (Popeska, Jovanova-Mitkovska 2016: 263).

Existing scientific principles are closely linked to physical education, so that through an integrative approach in physical education teaching, students are trained in real-life situations, and students' motor performance will be enhanced at the same time (Gagen, Getchell 2008). An integrative approach facilitates instruction in physical education teaching, that is, communication between teachers and students that affects their concentration and cognition (Coral, Lleixà 2016). When applying the integrative approach, students can: acquire new skills in teaching physical education with integrated content; be encouraged to think by demonstrating integration; strengthen their skills needed for other teaching subjects (Solomon, Murata 2008). In this way, the critical thinking of students is strengthened (Wachob 2014).

Furthermore, students often cannot complete the task ahead of them because of the complexity of the content in which the task is embedded (Furner, Kumar 2007). An integrative approach in teaching physical education, through the application of logical-mathematical games, enables students to acquire functional knowledge. Moreover, strong links between physical activity and academic achievement in students have been demonstrated (Singh et al. 2012), and learning can enhance mathematical achievement if physical activity is involved in the learning process (Beck et al. 2016). It is necessary for mathematical knowledge acquired in school to be applicable in life situations (Kitchen, Kuehl Kitchen 2013), and moving activities encourage more efficient functioning of thought activities and more effective teaching through active student engagement.

Requirements for students can be solved more efficiently by analysing the tasks. If these requirements are set for students in real life contexts, students practice and develop their skills during the work, divide the requirements into simpler units, critically approach the problem and find a solution. Developing critical thinking in a real life environment, i.e. situations, can be considered as a response to increasingly complex life demands that include multitasking, i.e. performing multiple actions simultaneously or using multiple skills at the same time (Patel 2003). In this way, students will be competent in several different disciplines at the

same time in future schooling, but also in life and future work (Li 2012). Based on the above, we can conclude that education as a process of acquiring knowledge must be viewed as a mutually integrated whole of individual scientific disciplines, and not as an individual acquisition of knowledge from different scientific disciplines. An important role in such a process is the integrative approach, which provides the possibility of practical application of knowledge of several scientific disciplines at the same time, which further indicates the need to develop a different curriculum (Miloradović 2019).

As over 80% of children in Europe are active during the day only in school (ECEG 2015), it is pointed out the need to design and implement such programs that would improve the health status of students, and thus motor skills through such programs that respond to the demands of modern life such as multitasking. An integrative approach in the teaching of physical education is in the focus of many researchers (Miloradović 2019). However, the focus of these studies is mostly on theoretical foundations and examples of good practice in working with students. What has also been observed is that a large percentage of such researches relate to the integration of teaching physical education and English as a mother tongue or as a second language. It is evident as well that empirical and theoretical research studies emphasize the positive impact of such programs in the domains of: critical thinking, cooperation, self-regulation of learning, practical application of knowledge, academic achievement, interdisciplinary competencies. The link between physical activity and learning, whereby children are simultaneously active and able to achieve academic success is positive and can be long lasting (Smith 2015).

Although the presence of an integrative approach in the teaching of physical education is expanding, it is noticed that research studies in the field of integration with mathematics are negligible. However, they are of great importance for the improvement of integrative approach in teaching. They emphasize the positive impact on students, except in the previously mentioned domains, and in increasing the percentage of daily physical activities of students.

For the integrative approach in physical education teaching, student motivation is also very important (Marttinen et al. 2017). Students have the opportunity to apply their experiences gained in other teaching areas to physical education classes, which can further positively influence students' motivation (Konukman, Marx 2009). In this way, students will become more actively involved in specially designed logical-mathematical games that are used in physical education classes, while students with lower scores in mathematics will be motivated by acquiring functional knowledge.

Numerous analyzed studies were carried out on a small sample of respondents. Besides there is a lot of theoretical research studies, some of the common disadvantages of experimental research are the short time interval of research and the classroom conditions for the implementation of experimental programs. What was examined in such studies refers to motivation, mathematical achievements and the

increase in the percentage of students' daily physical activities. Analyzing the studies on the integrative approach in teaching physical education and mathematics, it was observed that they did not sufficiently deal with the effects of the application of the integrative approach in teaching physical education on the development of motor skills and skills in using logical-mathematical games, especially in the first grade of elementary school. With this in mind, a more detailed search is needed, as well as the analysis of the research, which is also presented in this paper.

METHOD

Literature search, based on key characteristics for the purposes of this paper: integrative approach in physical education, logical-mathematical games, academic achievements and motor abilities and skills of students, was performed in several electronic databases: Taylor & Francis, ELSEVIER, ERIC PubMed, IJSR, Research Gate. Based on the analysis of the searched literature, the publications related to: primary school students and physical education classes, and physical activity with different didactic-methodological aspects of work in schools were considered. The authors of this paper performed a special literature search based on the references listed in the analyzed publications. The analyzed research studies, further in this paper, are defined and used by deduction on the integrative approach in teaching physical education, correlations between academic achievement and physical skills and abilities, integrative approach in physical education with mathematics in order to reach the primary focus of this paper on integrative approach in physical education using logical-mathematical games. Criteria include both empirical and theoretical data in defined areas. In addition, the authors considered references published exclusively in English, published in full text and with restriction according to the last 20 years of publication. Initially, 51 articles were identified for the purpose of our review. Only 9 articles met the inclusion criteria which were coded by the age of the respondents (primary schools), and logical-mathematical games. Theoretical studies were not excluded. However, three studies were theoretical and six were identified as empirical.

INTEGRATIVE APPROACH AND LOGICAL-MATHEMATICAL GAMES IN TEACHING PHYSICAL EDUCATION

In numerous research studies, logical-mathematical games were created as a result of integration of physical education and mathematics contents and were applied mostly in "classroom" conditions (Vazou et al. 2018; White, McCoy 2019; Vazou, Skrade 2016; Snyder et al. 2017). In addition, the previously mentioned studies are characterized by one common characteristic, and that is the age of the

participants, which does not refer in any case to the youngest school age, i.e. to the first grade of primary schools. Some researchers also point to a low level of active exercise time of preschool children between the ages of six and seven (Markovic, Ignjatovic 2015). Two of the analyzed studies (Hraste et al. 2018; Riley 2016) refer to the application of logical-mathematical games both in the gym and classroom, but as previously mentioned, the participants were not the youngest learners, i.e. first grade primary school students. Additionaly, some of the analyzed studies refer to theoretical instructions, assumptions or features of the integrative approach and application of logical-mathematical games in the teaching of physical education (Wade 2016; Kitchen, Kuehl Kitchen 2013; DeFrancesco, Casas 2004).

Table 1. Integrative approach and logical-mathematical games in teaching physical education in primary schools

Authors	Y	TS / ES	C / G	SD	S	CG	MIO
DeFrancesco & Casas	2004	T	/	/	/	2^{th}, 4^{th}, 5^{th}, 6^{th}	Motivation, fun, motor skills
Kitchen & Kuehl Kitchen	2013	T	/	/	/	4^{th}	Motivation, engagement, experience, application of knowledge
Riley	2016	E	C and G	6 weeks	66	5^{th}	Motivation, percent of physical activity during school day
Vazou & Skrade	2016	E	C	8 weeks	118	4^{th}, 5^{th}	Academic achievement
Wade	2016	T	/	/	/	2^{nd}, 4^{th}	Motivation, application of knowledge
Snyder et al.	2017	E	C	5 weeks	34	3^{rd}	Academic achievement, percent of physical activity during school day
Hraste et al.	2018	E	C and G	3 weeks	36	4^{th}	Geometry achievement
Vazou et al.	2018	E	C	1 week	77	4^{th}	Cognition, academic achievement, percent of physical activity during school day
White & McCoy	2019	E	C	1 week	24	5^{th}	Motivation, academic achievement, critical thinking

Legend: Y – year of publication, TS – theoretical study, ES – empirical study, C – classroom conditions, G – gym conditions, SD – study duration, S – sample, CG – class grade, MIO – main impact on.

Table 1 represents nine studies relevant to the integrative approach in physical education using logical-mathematical games in primary schools. The main impact of the mentioned studies is pointed out. As can be noticed, three research studies are of theoretical character and all of them point out the benefits of an integrative approach to student motivation, gaining student experience during work and practical application of knowledge. Only one study (DeFrancesco, Casas 2004) of the three previously mentioned (DeFrancesco, Casas 2004; Kitchen, Kuehl Kitchen 2013; Wade 2016), indicates benefits in motor skills. The other six studies presented in Table 1 are empirical. Four (Vazou, Skrade 2016; Snyder et

al. 2017; Vazou et al. 2018; White, McCoy 2019) of the previously mentioned six studies were carried out in classroom conditions. It can be concluded that the focus of these researches refers to the academic achievements of students. Furthermore, the remaining two researches (Riley 2016; Hraste et al. 2018) were conducted in both classroom and gym conditions. Although the gym conditions are more favourable for the development of motor abilities and skills, the effects of experimental programs in this domain have not been researched. The common characteristics of all nine previously mentioned researches are the following: a short research period, a small sample of respondents, the age of the respondents – the youngest school age is not included.

The integrative approach in teaching physical education and mathematics refers to a large percentage of theoretical considerations (Rauschenbach 1996; De-Francesco, Casas 2004; Hatch, Smith 2004; Donnelly et al. 2009; Wittberg et al. 2012; Kitchen, Kuehl Kitchen 2013; Vazou, Skrade 2016; Riley et al. 2016; Marttinen et al. 2017). The papers present the possibilities of integrating the content of physical education and mathematics. Defining an integrative approach in teaching, a unique whole of what is taught, i.e. holism as the basis of functional knowledge, is highlighted as a goal. The following issues are highlighted as well: positive social aspect of learning; improvement of students' mathematical achievements through motor activities; students who were acquiring mathematical contents through physical activities which engage both gross and fine motor skills had better results on knowledge tests compared to students who were taught in traditional way. One of the benefits of an integrative approach in teaching physical education and mathematics is certainly an increase in the percentage of daily physical activities among students, which is partly limited by classroom conditions. The mentioned papers report that there is an increase in students' motivation to learn the contents of both subjects, a higher level of student cooperation, as well as an element of fun in the learning process.

In many research studies logical-mathematical games are characterized by the simplicity of organization and adoption of the content, elementary forms of movement, the possibility of performance in different conditions. It has also been pointed out that the number of students is not a limiting factor in organizing games. Logical-mathematical games have a positive effect on students' mathematical achievements (White, McCoy 2019). According to the aforementioned authors, the research indicated that the students had positive attitudes towards this way of learning, that their mathematical knowledge improved, as did their motivation and critical thinking. By applying logical-mathematical games, a positive impact on physical education classes and on students' mathematical achievements is evident (Vazou, Skrade 2016). In addition to the previously mentioned benefits of logical-mathematical games, a positive impact on the level of students' health (Have et al. 2018), on the development of logical thinking (Rondina, Roble 2019), as well as on the holistic development of students, cognition and academic success were also

noted (DeFrancesco, Casas 2004). Although the papers dealing with the application of logical-mathematical games are scarce, whether they are of theoretical or empirical nature, they should not be neglected. Examples of good practice cannot lose their quality (Wade 2016). Activation of brain function, positive impact on learning processes by creating logical connections between contents, holistic development of students are just some of the benefits of applying logical-mathematical games in physical education classes (Kitchen, Kuehl Kitchen 2013).

The methods of teaching are based on the curriculum that develops concepts and skills through integrative approach, and such an approach stimulates children to explore, analyze problems in order to reach a solution, creatively think and work with others, focus on the task. In this way, children set the stage for further development of skills and competencies (California Department of Education 2016). Shah and Jain (Shah, Jain 2016) state that it is essential that students develop their research skills in order to consolidate their knowledge into one whole and be competent in different disciplines which is necessary and useful for a society as a whole. The results of this study confirm that integrative teaching was more effective than traditional one; that integrative approach contributes to the acquisition of knowledge in upper grades as well (Toppo et al. 2016). Students expressed their satisfaction by pointing out that learning was more useful, more interesting, interactive, and that they understood the content better. Qualitative research on integrative approach in teaching physical education and mathematics (Chen et al. 2011) indicates an increase in the motivation to learn both subjects and an increase in the level of students' cooperative learning. The importance of logic-mathematical games is also reflected in the element of fun that accompanies this type of student activity during a school day (DeFrancesco, Casas 2004). There are numerous studies regarding positive correlation of physical activity and student academic achievement (Singh et al. 2012; Donnelly et al. 2016; Syväoja et al. 2012; Ardoy et al. 2014; Castelli et al. 2007; Ericsson et al. 2014; Hillman et al. 2014; Lees, Hopkins 2013; Morales et al. 2011; Roberts et al. 2010; Sibley, Etnier 2003; Wittberg et al. 2012), but, although this correlation is positive, research on integration of mathematical and physical education contents in teaching is scarce (Marttinen et al. 2017).

Logical-mathematical games in teaching physical education contribute to the stimulation of brain activities through motor activities, stimulating both the locomotor apparatus and mathematical skills (Wade 2016). Logical-mathematical games are based on general characteristics of elementary games, which have positive effects on active time of exercise in physical education classes using natural form of movement (Markovic et al. 2016). As logical-mathematical games refer to teaching both physical education and mathematics, it has been proven that it is more efficient to learn mathematical and logical concepts through practical application than through traditional knowledge transfer (Stanković 2017). Physical education can be successfully integrated with other areas of learning, in different

ways, through different subjects, and it significantly contributes to improving students' academic achievement and developing their versatility. Numerous research papers offer a great diversity of proposals for integrating physical education with other subjects such as mathematics (DeFrancesco, Casas 2004; Kitchen, Kuehl Kitchen 2013). In addition to cognition and academic achievement (Vazou et al. 2018), logical-mathematical games also have a positive effect on student motivation (White, McCoy 2019). Although there are numerous possibilities of integrating physical education with other subjects (Ignjatović, Miloradović 2018), those related to mathematics are few (Miloradović 2019). Therefore, there is a need for examining integrative teaching of physical education using logical-mathematical games in order to examine the effects of this model of teaching on young learners' motor abilities and skills, and to improve teaching practice in the future.

CONCLUSION

The literature overview shows the existence of a large number of publications on the integrative approach in teaching physical education through "classroom" subjects. Based on the analysis of the research studies, we conclude that, first of all, it is necessary to pay special attention to the ways of integrating teaching contents of physical education and mathematics, so that the integration is complete. Additionally, the youngest learners have not been is the focus of research in this area. The benefits of an integrative approach in teaching physical education using logical mathematical games are numerous: positive influence on improving motor skills, on the academic success in mathematics, increasing the time of active practice during the day, having fun, student cooperation during work, positive influence on student health, practical application of knowledge, positive impact on critical thinking and motivation, and many others.

REFERENCES

Ardoy, Fernandez-Rodriguez, Jimenez-Pavon, Castillo, Ruiz, Ortega (2014): D. N. Ardoy, J. M. Fernandez-Rodriguez, D. Jimenez-Pavon, R. Castillo, J. R. Ruiz, F. B. Ortega, A physical education trial improves adolescents' cognitive performance and academic achievement. The EDUFIT study, *Scandinavian Journal of Medicine and Science in Sports*, 24(1), 52–61.

Beck, Lind, Geertsen, Ritz, Lundbye–Jensen, Wienecke (2016): M. M. Beck, R. R. Lind, S. S. Geertsen, C. Ritz, J. Lundbye-Jensen, J. Wienecke, Motor-Enriched Learning Activities Can Improve Mathematical Performance in Preadolescent Children, *Frontiers in Human Neuroscience*, 10, 1–14.

California Department of Education (2016): *The Integrated Nature of Learning*, Sacramento.

Castelli, Hillman, Buck, Erwin (2007): D. M. Castelli, C. H. Hillman, S. M. Buck, H. E. Erwin, Physical fitness and academic achievement in third and fifth grade students, *Journal of Sport and Exercise Psychology*, 29(2), 239–252.

Coral, Lleixà (2016): J. Coral, T. Lleixà, Physical education in content and language integrated learning. Successful interaction between physical education and English as a foreign language, *International Journal of Bilingual Education and Bilingualism*, 19(1), 108–126.

Chen, Cone, Cone (2011): W. Chen, T. P. Cone, S. L. Cone, Students' voices and learning experiences in an integrated unit, *Physical Education and Sport Pedagogy*, 16(1), 49–65.

DeFrancesco, Casas (2004): C. DeFrancesco, B. Casas, Elementary Physical Education and Math Skill Development, *Strategies. A Journal for Physical and Sport Educators*, 18(2), 21–23.

Donnelly, Greene, Gibson, Smith, Washburn, Sullivan, DuBose, Mayo, Schmelzle, Ryan, Jacobsen, Williams (2009): J. E. Donnelly, J. L. Greene, C. A. Gibson, B. K. Smith, R. A. Washburn, D. K. Sullivan, K. DuBose, M. S. Mayo, K. H. Schmelzle, J. J. Rayan, D. J. Jacobsen, S. L. Williams, Physical Activity Across the Curriculum (PAAC): A randomized controlled trial to promote physical activity and diminish overweight and obesity in elementary school children, *Preventive Medicine*, 49(4), 336–341.

Donnelly, Hillman, Castelli, Etnier, Lee, Tomporowski, Lambourne, Szabo Reed (2016): J. E. Donnelly, C. H. Hillman, D. Castelli, J. L. Etnier, S. Lee, P. Tomporowski, K. Lambourne, A. N. Szabo Reed, Physical Activity, Fitness, Cognitive Function, and Academic Achievement in Children. A Systematic Review*, Medicine and Science in Sports and Exercise*, 48(6), 1197–1222.

ECEG on Health-enhancing physical activity (2015): *Recommendations to encourage physical education in schools, including motor skills in early childhood, and to create valuable interactions with the sport sector, local authorities and the private sector*. Retrived October 15th, 2015 from http.//ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetailDoc&id=19860&no=1 .

Ericsson, Karlsson (2014): I. Ericsson, M. Karlsson, Motor skills and school performance in children with daily physical education in school – A 9-year intervention study, *Scandinavian Journal of Medicine and Science in Sports*, 24(2), 273–278.

Furner, Kumar (2007): J. M. Furner, D. D. Kumar, The Mathematics and Science Integration Argument. A Stand for Teacher Education, *Eurasia Journal of Mathematics, Science & Technology Education*, 3(3), 185–189.

Gagen, Getchell (2008): L. Gagen, N. Getchell, Applying Newton's Apple to Elementary Physical Education, *Journal of Physical Education, Recreation and Dance*, 79(8), 43–51.

Hillman, Pontifex, Castelli, Khan, Raine, Scudder, Kamijo (2014): C. H. Hillman, M. B. Pontifex, D. M. Castelli, N. A. Khan, L. B. Raine, M. R. Scudder, K. Kamijo, Effects of the FITKids Randomized Controlled Trial on Executive Control and Brain Function, *Pediatrics*, 134(4), 1063–1071.

Hatch, Smith (2004): G. M. Hatch, D. R. Smith, Integrating Physical Education, Math, and Physics, *Journal of Physical Education, Recreation & Dance*, 75(1), 42–50.

Hraste, De Giorgio, Mandić Jelaska, Padulo, Granić (2018): M. Hraste, A. De Giorgio, P. Mandić Jelaska, J. Padulo, I. Granić, When mathematics meets physical activ-

ity in the school-aged child. The effect of an integrated motor and cognitive approach to learning geometry, *PLOS ONE*, 13(8), 1–14.

Ignjatović, Miloradović (2018): A. Ignjatović, B. Miloradović, Interdisciplinarni pristup u nastavi fizičkog vaspitanja u osnovnoj školi, *Zbornik radova Pedagoškog fakulteta u Užicu*, 20(21), 235–248.

Kitchen, Kuehl Kitchen (2013): D. Kitchen, J. Kuehl Kitchen, Integrating Physical Education and Mathematics. A Collaborative Approach to Student Learning, *Strategies. A Journal for Physical and Sport Educators*, 26(1), 31–38.

Konukman, Marx (2009): F. Konukman, A. C. Marx, An Interdisciplinary Approach to Physical Education and Sport, *Journal of Physical Education, Recreation and Dance*, 80(4), 12–13.

Lees, Hopkins (2013): C. Lees, J. Hopkins, Effect of aerobic exercise on cognition, academic achievement, and psychosocial function in children. A systematic review of randomised control trials, *Preventing Chronic Disease*, 10(10), 1–8.

Li (2012): N. Li, *Approaches to learning: Literature review, IB research paper*, International Baccalaureate Organization.

Markovic, Dzinovic Kojic, Ignjatovic, Sekeljic, Stankovic (2016): Z. Markovic, D. Dzinovic Kojic, A. Ignjatovic, G. Sekeljic, S. Stankovic, The influence of different contents on the motor engagement of preschoolers, *Facta Universitatis – Series Phyisical Education and Sport*, 14(3), 371–380.

Markovic, Ignjatovic (2015): Z. Markovic, A. Ignjatovic, Active time of exercising with directed activities, In M. Bratic (ed.), *Book of Proceedings*, XVIII Scientific Conference „FIS COMMUNICATIONS 2015" in physical education, sport and recreation and III International Scientific Conference, Niš, Serbia, October 15–17th, 2015 (pp. 190–196), Nis: Faculty of Sport and Physical Education.

Marttinen, McLounghlin, Frederick III, Novak (2017): R. H. J. Marttinen, G. McLounghlin, R. Frederick III, D. Novak, Integration and Physical Education. A Review of Research, *Quest*, 69(1), 37–49.

Miloradović (2019): B. Miloradović, Integrativna nastava fizičkog vaspitanja i matematike, *Uzdanica*, 16(2), 236–273.

Morales, Gomis, Chenoll, Garcia-Masso, Gomez, Gonzalez (2011): J. Morales, M. Gomis, M. Chenoll, X. Garcia-Masso, A. Gomez, L. M. Gonzalez, Relation between physical activity and academic performance in 3rd year secondary education students, *Perceptual and Motor Skills*, 113(2), 539–546.

Patel (2003): N. V. Patel, A Holistic Approach to Learning and Teaching Interaction. Factors in the Development of Critical Learners*, The International Journal of Educational Management*, 17(6/7), 272–284.

Popeska, Jovanova Mitkovska (2016): B. Popeska, S. Jovanova Mitkovska, Integration and correlation Concepts in Physical Education, *Research in Kinesiology*, 44(2), 262–269.

Rauschenbach, J. (1996): J. Rauschenbach, Tying it all Together Integrating Physical Education and other Subject Areas, *Journal of Physical Education, Recreation and Dance*, 67(2), 49–51.

Riley, Lubans, Holmes, Hansen, Gore, Morgan (2016): N. Riley, D. Lubans, K. Holmes, V. Hansen, J. Gore, P. Morgan, Movement-based Mathematics. Enjoyment and

Engagement without Compromising Learning through the EASY Minds program, *EURASIA Journal of Mathematics Science and Technology Education*, 13(6), 1653–1673.

Roberts, Freed, McCarthy (2010): C. K. Roberts, B. Freed, W. J. McCarthy, Low Aerobic Fitness and Obesity Are Associated with Lower Standardized Test Scores in Children, *The Journal of Pediatrics*, 156(5), 711–718.

Rondina, Roble (2019): J. Q. Rondina, D. B. Roble, Game-Based design Mathematics Activities and Students' Learning Gains, *The Turkish Online Journal of Design, Art and Communication*, 9(1), 1–7.

Shah, Jain (2016): V. Shah, U. J. Jain, The Effectiveness of Integrated Teaching over Traditional Teaching in third MBBS students, *International Journal of Medical Science and Public Health*, 5(7), 1430–1432.

Singh, Uijtdewilligen, Twisk, Mechelen, Chinapaw (2012): A. Singh, L. Uijtdewilligen, J. W. R. Twisk, W. V. Mechelen, M. J. M. Chinapaw, Physical Activity and Performance at School. A Systematic Review of the Literature Including a Methodological Quality Assessment, *Pediatrics & Adolescent Medicine*, 166(1), 49–55.

Sibley, Etnier (2003): B. A. Sibley, J. L. Etnier, The relationship between physical activity and cognition in children. A meta-analysis, *Pediatric Exercise Science*, (15), 243–256.

Smith (2015): J. Smith, *BRAIN BOOST how sport and physical activity enhance children's learning what the research is telling us*. Centre for Sport and Recreation Research, Curtin University. This document is an updated version of Martin K. E., 2010 Brain Boost Sport and Physical Activity Enhance Children's Learning, The University of Western Australia, Department of Sport and Recreation.

Snyder, Dinkel, Schaffer, Hiveley, Colpitts (2017): K. Snyder, D. Dinkel, C. Schaffer, S. Hiveley, A. Colpitts, Purposeful Movement. The Integration of Physical Activity into a Mathematics Unit, *International Journal of Research in Education and Science*, 3(1), 75–87.

Solomon, Murata (2008): J. Solomon, H. M. Murata, Physical Education and Language Arts. An Interdisciplinary Teaching Approach, *Strategies. A Journal for Physical and Sport Educators*, 21(6), 19–23.

Stanković (2017): S. Stanković, Mogućnost korelacije fizičkog vaspitanja i matematike u predškolskom uzrastu, *Uzdanica*, 14(1), 197–205.

Syväoja, Kantomaa, Laine, Jaakkola, Pyhältö, Tammelin (2012): H. Syväoja, M. Kantomaa, K. Laine, T. Jaakkola, K. Pyhältö, T. Tammelin, *Physical Activity and Learning*, Finnish National Board of Education.

Toppo, Lazarus, Seth, Bhargava, Yadav, Kasar (2016): N. A. Toppo, M. Lazarus, R. J. Seth, O. P. Bhargava, K. S. Yadav, P. K. Kasar, Introduction of Integrated Teaching Learning Module in Second M.B.B.S. Curriculum, *International Journal of Contemporary Medical Research*, 3(5), 1275–1279.

Vazou, Saint–Maurice, Skrade, Welk (2018): S. Vazou, P. F. Saint–Maurice, M. Skrade, G. Welk, Effect of Integrated Physical Activities with Mathematics on Objectively Assessed Physical Activity, *Children*, (5), 1–10.

Vazou, Skrade (2016): S. Vazou, M. A. B. Skrade, Intervention integrating physical activity with math. Math performance, perceived competence, and need satisfaction, *International Journal of Sport and Exercise Psychology*, 1–15.

Wachob (2014): D. Wachob, Using Physical Education to Improve Literacy Skills in Struggling Students, *Strategies. A Journal for Physical and Sport Educators*, 27(5), 12–17.

Wade (2016): M. Wade, Math and Movement. Practical Ways to Incorporate Math into Physical Education, *Strategies*, 29(1), 10–15.

White, McCoy (2019): K. White, L. P. McCoy, Effects of Game-Based Learning on Attitude and Achievement in Elementary Mathematics, *Networks. An Online Journal for Teacher research*, 21(1), 1–19. Retrieved in July 2020 from https.//doi.org/10.4148/2470–6353.1259 .

Wittberg, Northrup, Cottrell (2012): R. A. Wittberg, K. L. Northrup, L. A. Cottrell, Children's Aerobic Fitness and Academic Achievement. A Longitudinal Examination of Students During Their Fifth and Seventh Grade Years, *American Journal of Public Health, Research and Practice*, 102(12), 2303–2307.

Бојан Д. Милорадовић

Универзитет у Крагујевцу
Факултет педагошких наука у Јагодини
Студент докторских студија

Живорад М. Марковић

Александар М. Игњатовић

Катедра за дидактичко-методичке науке

ИНТЕГРАТИВНИ ПРИСТУП У НАСТАВИ ФИЗИЧКОГ И ЗДРАВСТВЕНОГ ВАСПИТАЊА ПРИМЕНОМ ЛОГИЧКО-МАТЕМАТИЧКИХ ИГАРА

Резиме: Интегративни приступ у настави подразумева обједињавање курикулума различитих предмета, представљајући природну, логичку и практичну повезаност појединачних научних дисциплина. Интегративни приступ у настави физичког и здравственог васпитања коришћењем логичко-математичких игара пружа широк спектар могућности у примени и организацији наставе, побољшавајући квалитет наставе која може да одговори потребама мултитаскинга и савременог живота. У таквом процесу ученици су мотивисани за рад у циљу стицања знања, што им омогућава и практичну примену стеченог знања. Такође, подстиче се критичко мишљење ученика и повећава се време активног вежбања, што подстиче когнитивни развој ученика и позитивно утиче на математичка постигнућа ученика. Методологија избора релевантних радова извршена је на основу претраживања у електронским базама података, а изабрани су они који садрже елементе интегративног приступа у области истраживања. На основу анализе истраживања идентификована је 51 публикација, а само 9 публикација објављених у протеклих 20 година задовољило је критеријуме овог рада. Потреба за детаљнијим истраживањима у овој области је евидентна, како због недовољног броја истраживања, тако и због испитивања ефеката интегративног

приступа у настави физичког и здравственог васпитања код моторичких способности и вештина најмлађих ученика.

Кључне речи: интегративни приступ, физичко и здравствено васпитање, логичко-математичке игре, математичка постигнућа.