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Editors: Prof. Dr. Aleksandar Ignjatović
Prof. Dr. Živorad Marković

STEPAM APPROACH IN CONTEMPORARY EDUCATION – CHALLENGES AND PERSPECTIVES –

THE BOOK OF ABSTRACTS



International Conference organized by the Faculty of Education,
University of Kragujevac, Jagodina, Serbia



Jagodina, 11-12. 05. 2026.





УНИВЕРЗИТЕТ
У КРАГУЈЕВЦУ
UNIVERSITY
OF KRAGUJEVAC



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НАУКЕ И ТЕХНОЛОШКОГ РАЗВОЈА



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Contents

Exploring Educational Innovations and the Future of Learning through STEAM	9
<i>Zsolt Lavicza</i>	
Don't Stop Me Now! Wellbeing and Embodied Learning Through STEAM Education	9
<i>Kristof Fenyvesi</i>	
Joyful Learning in the Future Classroom: A Convergence Education Framework for Human Flourishing and Student Wellbeing	10
<i>MI Yung Hong</i>	
Unpacking Essential Skills for Mathematics Learners in the AI era	11
<i>Thomas Chiu</i>	
STEM Learning Activation among Lower Primary School Students	11
<i>Gordana Stepić, Nedeljko Milanović, Andrijana Miletić</i>	
Possibilities for Preventive and Therapeutic Interventions in Hypertension Among Young People in Contemporary Education	12
<i>Dragan Radovanović</i>	
Outdoor STEAM Education: Opportunities and Challenges	13
<i>Ena Biševac, Nataša Krstić, Kristina Randelović</i>	
Music–Movement Integration in Early Childhood	13
<i>Sladana Stanković, Jelena Grkić Ginić</i>	
Will robots replace teachers? Teachers' opinions on the impact of artificial intelligence on the teaching profession within the STEAM approach	14
<i>Nenad Stevanović</i>	
Electronic Textbooks as Support for STE(PA)M Education: Challenges and Opportunities in Embodied Learning	14
<i>Adisa Šahović Džanković</i>	
Analysis of Tests for Assessing Motor Abilities	15
<i>Živorad Marković</i>	
Articulation Development Through Rhythm, Movement and Song: An Interdisciplinary STEPAM Approach in Preschool Education	16
<i>Maja Nešić</i>	

Physical Education for All: Integrating Inclusive Games into the Educational Process 16

Živan Milošević

Implementation of STEAM packages: Effects on teachers from the first educational cycle 17

Ivana Stepanović Ilić, Marina Videnović, Milana Dabić Boričić

Integration of Digital Educational Technologies and Student Motivation in Physical Education 18

Tamara Tonic

Acquisition of Dialectological Vocabulary by Students 18

Milica Mitić

Unplugged Activities, Educational Robotics, or Screen-Based Applications? Slovenian Preschool Teachers' Preferences for Promoting Computational Thinking 19

Jakob Škrobar, Alenka Lipovec

Visualization of Rhythm in Music Education Through Dynamic Mathematical Models 19

Milan Milikić, Ivana Milić

Development of Computational and Mathematical Thinking in Early Childhood Education Using an Educational Robot 20

Milan Milikić, Aleksandar Milenković

Narrative as a Framework for STEP(A)M Activities – From The Conceited Peacock to Integrated Learning 21

Ivana Krulj, Aleksandra Mihajlović

STEAM Integration in Mathematics Education: Modeling the Optical Properties of the Parabola through Art Installation 21

Radoslav Božić

Designing Interdisciplinary Project-Based Learning for Heterogeneous Groups 22

Carla Barreiros, Marjorie Da Cruz, Nelson Silva

From Head to Toe: A Day of Discovery and Movement in Early Childhood Language Learning 23

Sandra Tasić

Theoretical Contributions and Practical Challenges in the Reconceptualization of Early Learning through the STEPAM Approach 23

Daliborka Popović

Development of Psychological Competencies Relevant to the Workplace through STEAM Education	24
<i>Ensar Leković, Denis Demirović</i>	
Between Screens and Movement: The Role of Mass Media in Shaping Youth Physical Activity in Leisure Time	25
<i>Biljana Popeska, Despina Sivevska</i>	
Dancing with Physics: Design-Based Research as a Framework for Developing a Physics Embodying Learning Lab	25
<i>Abril Armenta Franco, Eva Ulbrich, Zsolt Lavicza</i>	
From MOOC to Motion: Experiencing and Designing STEPAM-Based Embodied Learning Activities with Pre- and In-Service Teachers	26
<i>Abril Armenta Franco, Guillermo Bautista Jr., Zsolt Lavicza</i>	
Integration of Digital Technologies in the STEPAM Approach as a Model of Contemporary Preschool Education	27
<i>Marija Krstić Radojković</i>	
The Effects of Gamification and Exergaming in Physical Education in Primary School - Review Article	28
<i>Ana J. Lilić, Sara, J. Perković, Stefan M. Mijalković, Nikola S. Prvulović</i>	
Primary School Students' Perceptions and Attitudes Toward STEPAM Approach?	28
<i>Olivera Cekić Jovanović, Aleksandra Mihajlović, Aleksandar Ignjatović</i>	
Language Acquisition Through Music and Movement	29
<i>Jelena Spasić, Nataša Vukićević</i>	
A Systematic Review of Physical Activity Integration in STEAM Education: Pedagogical Approaches, Learning Outcomes, and PA-STEAM Framework	29
<i>Josephine Lau, Aleksandar Ignjatović, Marjorie Cristina Da Cruz, Olivera Cekić-Jovanović, Kristóf Fenyvesi, Zsolt Lavicza</i>	
Does Physical Education and Health Belong in STEM? A Meta-Analysis of STEPAM Integration Effects	30
<i>Muhammet Usak</i>	
A pilot Acceptance and Commitment training program's effect on college students	31
<i>Luca Pump, Zoltán Kiss</i>	

STEM in Mathematics Education in Vietnam: Real-World Problem Contexts, Interdisciplinary Knowledge Integration, and Mathematical Problem-Solving Competency 31

Duc Lan Do

Encouraging Children's Development through the Integration of STEM and Early English Language Learning in the Transition from Kindergarten to School 32

Mira Jovanović, Sanja Vuletić, Nataša Dubljanin

Implementing the STEM approach in the education of Preschool and Early School Pedagogy students 33

Katarzyna Ziębakowska-Cecot

Multisensory and Interdisciplinary Learning as a Foundation for STEAM Education: A Montessori Pedagogical Perspective 33

Marija Lesandrić, Ana Mirosavljević

Music as the “Arts” Component in the STEAM Model: An Analysis of Science Festival Activities (2017–2025) 34

Zrinka Šimunović

Enhancing EFL Listening Through STEPAM-Based Instruction: Effects on Comprehension, Strategy Use, and Student Engagement 34

Marijana Matic

The Impact of School Physical Education on Fulfilling WHO Physical Activity Recommendations for Children and Adolescents 35

Badriya AL-Hadabi

Exploring Educational Innovations and the Future of Learning through STEAM

Zsolt Lavicza¹

¹*Linz School of Education, Johannes Kepler University, Austria*

Abstract: This presentation outlines the evolving landscape of STEAM education at the Linz School of Education, where technology and pedagogy intersect to spark creativity and deepen learning. With a special focus on mathematics education, we explore how innovative teaching strategies and interdisciplinary approaches foster creative thinking. Key collaborations, including those with the Experience Workshop Movement and the global GeoGebra community, showcase the integration of cutting-edge technologies into modern classrooms. Specifically, we investigate the practical application of Augmented Reality (AR), Virtual Reality (VR), 3D printing, machine learning, and mobile-based experiments to transform abstract concepts into tangible experiences. Central to this discussion is the transformative potential of 3D technologies in enhancing spatial and mathematical understanding, effectively bridging the gap between digital modeling and physical learning environments. Furthermore, we examine how Big Data analytics and learning analytics can be leveraged to uncover, track, and nurture these complex, creative thinking processes in real time. By embracing these socio-technological advancements, educators can open new pathways for cross-border innovation and collaboration. Finally, this presentation will outline the specific institutional initiatives, makerspaces, and advanced doctoral research facilities currently being developed at Johannes Kepler University (JKU). These frameworks aim to empower the next generation of researchers and practitioners, ultimately shaping a more interactive, inclusive, and technologically fluent future for STEAM education globally.

Keywords: *STEAM Education; Mathematics Education; Learning Analytics*

Don't Stop Me Now! Wellbeing and Embodied Learning Through STEAM Education

Kristof Fenyvesi¹

¹*Finnish Institute for Educational Research, Finland*

Abstract: This presentation calls to rethink mathematics learning through embodied cognition, movement pedagogy, dance, and collaborative experience. Drawing on research and pedagogical experimentation connected to embodied mathematics education, STEAM learning, and wellbeing-oriented pedagogy, we examine how bodily movement can function not merely as motivational support, but as a genuine epistemological pathway into mathematical understanding. Mathematics didactics in this context is situated within broader theoretical traditions including embodied cognition, engaging the work of scholars such as Lakoff, Núñez, Abrahamson, de Freitas, Sinclair, and Gerofsky. It highlights how movement-based mathematical activities enable learners to experience geometry, symmetry, rhythm, proportion, sequencing, and spatial reasoning through bodily enactment and social interaction rather than

solely through symbolic abstraction. Particular attention is given to implications for educational wellbeing. The presentation discusses how collaborative embodied learning environments may contribute to reducing mathematics anxiety, increasing inclusion and participation, strengthening professional agency among educators, and counteracting sedentary and overly screen-based learning cultures. The talk also reflects on the renewed relevance of embodied mathematics education in the age of generative AI, arguing that co-present, sensory, aesthetic, and relational dimensions of learning may become increasingly important as education systems confront digital overload, disengagement, and fragmentation of attention. Rather than positioning mathematics as detached symbolic manipulation, movement can reframe mathematical learning as lived, social, spatial, rhythmic, and embodied human experience.

Keywords: *Embodied Cognition; Embodied Mathematics Education; STEAM Education*

Joyful Learning in the Future Classroom: A Convergence Education Framework for Human Flourishing and Student Wellbeing

MI Yung Hong¹

¹*Korea National University of Education, South Korea*

Abstract: This presentation explores joyful learning in the future classroom as a serious educational condition for human flourishing, rather than as a light or decorative concept. It proposes convergence education as an educational ecology that connects knowledge, value, thinking, experience, method, and policy. Moving beyond subject integration, the framework asks not only what should be connected, but why it should be connected, how it can be designed, and toward what kind of life it should be directed. The presentation then links this framework to student wellbeing and risk prevention through lessons from Korean student case analysis and system reform. It argues that wellbeing is not an additional topic after academic learning or achievement; it is the condition that makes meaningful learning, participation, growth, and connection possible. Student wellbeing is understood as including emotional stability, psychological safety, relational belonging, resilience, help-seeking capacity, and meaningful daily functioning. Using Korean cases of student suicide deaths and attempts, the presentation examines risk factors across individual, family, school, peer, environmental, and cultural levels, while also emphasizing protective factors such as trusted adults, school belonging, counseling access, and support without stigma. A matrix framework is introduced to read cases across risk, protection, and intervention priorities, and to translate complex crises into practical system learning. The presentation concludes that future classrooms should not be defined only by technology. They should be designed as caring, connected, and responsive wellbeing systems in which students can learn well, connect deeply, seek help safely, return with dignity, and flourish.

Keywords: *Joyful Learning; Convergence Education; Student Wellbeing; Future Classroom; Educational Design*

Unpacking Essential Skills for Mathematics Learners in the AI era

Thomas Chiu¹

¹*Chinese University of Hong Kong, China*

Abstract: In this talk, Thomas Chiu examines the essential mathematical skills required for learners in the AI-driven era, drawing on a decade of research from the *International Journal of STEM Education*. Findings reveal that while STEM education has grown significantly, mathematics and technology remain underrepresented compared to science and engineering. The emergence of AI as an integral component of STEM education necessitates a re-evaluation of foundational competencies. Mathematics is central to AI literacy, underpinning key concepts such as classification, generalization, and probabilistic reasoning—core elements of machine learning and visual recognition systems. The presentation proposes the "CRAFT" framework to guide future mathematics education, emphasizing: Care (human-centered, personalized learning), Assessment (effective AI-based formative approaches), Future skills (AI, digital, and STEAM literacies), and Transdisciplinary learning (integrating diverse disciplines). Essential mathematical skills identified include algebra, calculus, and statistics, which are crucial for developing AI-enhanced STEAM education. As AI transforms both education and work, the presentation calls for greater integration of mathematics into active, transdisciplinary STEAM learning environments. It concludes by questioning whether mathematics educators will adapt to support student learning through AI and highlights the need for research and curriculum development to foster AI competency across all subject domains.

Keywords: *Transdisciplinary STEM Education; Mathematical Competencies in STEAM Education; Artificial Intelligence Literacy*

STEM Learning Activation among Lower Primary School Students

Gordana Stepić¹, Nedeljko Milanović¹, Andrijana Miletić¹

¹*University of Kragujevac, Faculty of Education, Jagodina, Serbia*

Abstract: STEM learning activation refers to the combination of dispositions, practices, and knowledge that enable success in proximal STEM learning experiences and encompasses fascination with STEM, values, beliefs about one's own competencies, and an innovative mindset. STEM learning activation is considered an important prerequisite for the development of long-term interest and engagement in scientific domains. The aim of this study was to examine the level of STEM learning activation among lower primary school students, as well as to identify differences with respect to gender and place of residence, and its relationship with academic achievement. The study was conducted on a sample of 282 third-grade primary school students. A questionnaire was administered, including socio-demographic data and students' academic achievement, as well as a single-factor scale for assessing STEM learning activation. The results indicate that students demonstrate a relatively high level of STEM learning activation. The highest values were observed in dimensions related to valuing science, while the lowest values were found in aspirations toward STEM careers. No statistically significant gender differences were identified, whereas students from urban areas showed higher levels of activation in certain dimensions, indicating the influence of context and access to resources. A weak but statistically significant positive correlation was found between academic achievement

and STEM learning activation, suggesting that students with higher achievement demonstrate greater engagement in the STEM domain. Overall, STEM learning activation is confirmed as a dynamic and developmentally sensitive construct, influenced by environmental factors. Accordingly, the findings highlight the need to develop inquiry- and problem-based teaching, integrate creative and engineering activities into instruction, strengthen early STEM career aspirations, and reduce disparities in access to STEM resources.

Keywords: *STEM Learning Activation; Lower Primary School Students; STEM Careers*

Possibilities for Preventive and Therapeutic Interventions in Hypertension Among Young People in Contemporary Education

Dragan Radovanović¹

¹*Department of Medical Subjects, Faculty of Sports and Physical Education, University of Niš, Serbia*

Abstract: Significance and context of the problem: Hypertension is a well-established and modifiable risk factor for premature disability and mortality. Although the majority of adverse clinical outcomes manifest in adulthood, growing evidence indicates that elevated blood pressure represents a lifelong condition that may originate in childhood or adolescence and persist into later life. Objective: The aim of this paper is to provide a contemporary overview of arterial hypertension in children and adolescents, viewed through the physiological changes in blood pressure associated with growth and development. Methods: A systematic search of major international electronic databases was conducted using the following inclusion criteria: original research articles published in peer-reviewed journals with full-text availability and studies conducted on populations of children and adolescents aged 5–19 years. Results: The analyzed findings highlight important considerations regarding broader strategies for reducing the risk of premature cardiovascular disease beginning in childhood. While clinical approaches emphasize the identification of young individuals with elevated cardiovascular risk factors, equal attention should be directed toward public health strategies aimed at preserving optimal cardiovascular health in the general youth population. Conclusion: Young individuals with elevated blood pressure should adopt therapeutic lifestyle modifications, including body weight reduction, regular physical activity, appropriate dietary habits, and effective stress management. Implications: Effective preventive strategies may contribute to increased life expectancy, improved quality of life, and reduced economic burden on public health systems.

Keywords: *Youth; Hypertension; Prevention; Education*

Outdoor STEAM Education: Opportunities and Challenges

Ena Biševac¹, Nataša Krstić², Kristina Randelović³

¹ State University in Novi Pazar, Novi Pazar, Serbia

² Kjeller skole, Lillestrøm kommune, Serbia

³ OŠ Dositej Obradović, Niš, Serbia

Abstract: In contemporary educational conditions, marked by rapid technological, social, and cultural changes, there is an increasing need for teaching approaches that contribute to the development of competencies relevant to the 21st century. The STEAM approach represents an integrative framework that connects different disciplines, while outdoor learning provides an authentic context for its implementation through experiential and inquiry-based learning. The research is based on a theoretical analysis of relevant scientific and professional literature addressing the application of the STEAM approach and outdoor learning in the first cycle of primary education. The results indicate that outdoor learning represents a stimulating framework for the implementation of STEAM education, as it enables the development of scientific thinking, problem-solving skills, creativity, collaboration, and active student participation. At the same time, certain challenges have been identified, such as limited time for lesson implementation, a lack of material resources, and insufficient teacher preparedness for interdisciplinary work in an outdoor environment. The findings suggest that outdoor learning has significant potential for enhancing STEAM education; however, its successful implementation requires systematic planning, institutional and professional support, as well as continuous teacher professional development. Overcoming the identified limitations is a prerequisite for the full realization of the potential of this approach in contemporary education.

Keywords: STEAM Education; Outdoor Learning; First Cycle Of Primary Education

Music–Movement Integration in Early Childhood

Sladana Stanković¹, Jelena Grkić Ginić¹

¹ University of Kragujevac, Faculty of Education, Jagodina, Serbia

Abstract: Contemporary approaches to early childhood education increasingly affirm an integrative approach as a starting point in designing educational practice, with musical and motor activities occupying an important place within a developmentally supportive environment. Although relevant literature indicates a relationship between musical experience and motor development, this relationship has not yet been sufficiently theoretically systematized or methodologically operationalized within the field of preschool education. The paper examines the possibilities of integrating music and movement in early childhood education, based on the content, aims, and tasks of music and physical education, and offers a conceptual framework for their application. In this context, rhythm is emphasized as a structural element that enables the functional integration of musical and motor expression. The “Rhythm–Movement–Development” model is conceived as a conceptual framework that connects musical and motor activities through different levels of complexity. Its contribution is reflected in the systematization of activities, clearer definition of their structure, and the formulation of proposals for their application in work with preschool children. The integration of music and movement is considered in light of existing professional literature, highlighting its significance in the context of improving practice in the fields of music and physical education. The proposed model represents a theoretically grounded and methodologically applicable framework that

may serve as a basis for further professional considerations and the advancement of early childhood education practice.

Keywords: *Motor Development; Music; Rhythm; Early Childhood Education; Integration*

Will robots replace teachers? Teachers' opinions on the impact of artificial intelligence on the teaching profession within the STEAM approach

Nenad Stevanović¹

¹*University of Kragujevac, Faculty of Education, Jagodina, Serbia*

Abstract: This paper analyzes the impact of the application of artificial intelligence (AI) in education, particularly from the perspective of the teachers who follow STEPAM approach in teaching. With the development of AI in recent years, the debate in both professional circles and the broader public about the possibilities and risks of its use in education has been revived. Hence, the title alludes to the decades-long concern that one day robots might replace teachers. The first part of the paper provides an overview of recent relevant research on the effects of AI in education. The findings of these studies are critically analyzed in order to arrive at more objective insights into the real effects of AI in education. The second part analyzes the results of an empirical pilot study examining teachers' opinions on the effects of AI on education and on their own profession. Preliminary results indicate that teachers are aware of the inevitability of AI in education and the changes it brings, but they generally believe that AI will not replace teachers. They also point to potential risks and misuse of AI in education.

Keywords: *Effects of AI In Education; Technology and Education; Teaching Profession; STEPAM Approach in Teaching*

Electronic Textbooks as Support for STE(PA)M Education: Challenges and Opportunities in Embodied Learning

Adisa Šahović Džanković¹

¹*University of Kragujevac, Faculty of Education, Jagodina, Serbia*

Abstract: Contemporary education embraces the integration of digital technologies and innovative pedagogical approaches that steer teaching toward greater student engagement, experiential learning, and interdisciplinarity. The idea of combining electronic textbooks with the STE(PA)M approach may initially appear demanding, and their synergy with the concept of embodied learning may seem incompatible at first glance. However, numerous theoretical and empirical sources indicate that embodied learning is not merely an adjunct to digital technologies, but that the body, movement, and interaction with the environment can be effectively integrated into the design of electronic textbooks, thereby supporting the construction and deeper understanding of concepts. Sensorimotor activities and bodily interaction with content actively shape cognitive processes and enable learning rooted in the dialogue between mind, body, and context. This paper explores the challenges and opportunities in implementing embodied learning within electronic textbooks in the context of STE(PA)M

education, focusing on how digital technologies can support active student engagement and the enhancement of understanding abstract concepts. Existing research suggests that high levels of embodiment in technologically mediated learning experiences can improve knowledge acquisition and quality, transfer to new contexts, and student motivation for learning. The study provides an overview of theoretical foundations and practical implications for the design and use of electronic textbooks that integrate principles of embodied learning, highlighting the potential of this combination to enhance STE(PA)M instruction and interactive learning in formal education.

Keywords: *Electronic Textbooks; Digital Content Design; STE(PA)M Education; Embodied Learning; Interactive Learning*

Analysis of Tests for Assessing Motor Abilities

Živorad Marković¹

¹*University of Kragujevac, Faculty of Education, Jagodina, Serbia*

Abstract: Teachers and physical education instructors have the task and responsibility to monitor the physical development and the development of motor abilities of their students within physical and health education classes. In order to collect data on physical development and motor abilities, test batteries have been designed according to age categories. All tests were selected based on scientific knowledge, practical experience, and a number of studies presented through published scientific papers in this field. The aim of this paper is to provide a comparative analysis of certain tests from the Eurofit battery and tests from other batteries used in Serbia, as well as to define the factors that influence results in the assessment of motor abilities. A comparative analysis of selected tests from the mentioned batteries indicates differences in test protocols used to assess the same motor ability. In the Eurofit battery, flexibility is assessed using the sit-and-reach test, while in Serbia the deep forward bend on a bench is used. Balance is assessed by the Flamingo test versus standing lengthwise on a balance bench. Speed is assessed by the 10 × 5 m shuttle run, while in Serbia the 4 × 10 m shuttle run is used. For assessing repetitive strength of hip flexors, the Eurofit battery uses sit-ups in 30 seconds, while in Serbia trunk lifts on a bench are used. Endurance is assessed by the 20 m shuttle run in the Eurofit battery, while in Serbia running 500 m for girls and 800 m for boys is used. In addition to protocol differences, previous research indicates the influence of: environmental conditions - the subject alone, encouraged by the examiner, presence of classmates, presence of the opposite sex; competitive factor - two previously ranked subjects performing the test simultaneously; repeated testing, which in some cases leads to poorer results. The question remains regarding the competence of teachers and physical and health education instructors in understanding the test protocols within the proposed battery.

Keywords: *Assessment of Motor Abilities; Comparative Analysis of Test Batteries; Primary School Age*

Articulation Development Through Rhythm, Movement and Song: An Interdisciplinary STEPAM Approach in Preschool Education

Maja Nešić¹

Predškolska ustanova „Bambi“, Paraćin, Serbia

Abstract: Starting from the importance of early support for speech and language development, the paper explores possibilities for improving articulation through an interdisciplinary STEPAM approach in preschool education. The research problem focuses on examining how integrating rhythm, movement, song and structured speech activities can contribute to articulation development and children's active participation in learning. The aim of this action research was to investigate the effects of purposefully designed STEPAM-based activities on articulation development in preschool children. The study was conducted with children aged 5–6 in one preschool group. Observation, pedagogical documentation and progress monitoring were applied through structured articulation exercises of progressive complexity, rhythmic-musical activities, movement-based tasks and parental involvement. Findings indicate improvements in articulation accuracy, increased motivation, more active participation and enhanced verbal expression. The study concludes that integrating speech, music and movement provides a stimulating model for articulation development and broader competencies promoted by STEPAM education. Pedagogical implications highlight the value of interdisciplinary planning and the potential of this model within contemporary preschool curricula.

Keywords: *STEPAM Approach; Speech Articulation; Music And Movement; Action Research; Early Childhood Education*

Physical Education for All: Integrating Inclusive Games into the Educational Process

Živan Milošević¹

¹ Academy of Vocational Studies, Šabac, Department of Preschool Teachers and Nurse Preschool Teachers, Serbia

Abstract: The expanded and developed concept of integrative education, which transcends traditional disciplinary frameworks, provides opportunities for integrating scientific, technological, and artistic domains with physical education, aiming at the holistic development of the individual. The open structure of the STEAM model enables modifications of uniform physical education curricula, and the innovative inclusive game Baskin can serve as an example of good practice. Baskin represents an inclusive adapted activity whose fundamental principles derive from traditional basketball, played jointly on the court by players with and without disabilities. As a sport-for-all model, applied and grounded in the principles of Universal Design for Learning within the school system, Baskin offers potential for revising educational perspectives in physical education in accordance with the needs of contemporary society and global regulatory frameworks that promote inclusion in education. The aim of this paper is to analyze the potential application of the STEAM model in enhancing inclusion in physical education through the implementation of the Baskin game. The material, temporal, and spatial adaptations of this game indicate its potential to be implemented as an elective activity within school physical education. It can be concluded that the open structure of the STEAM model

provides opportunities for the flexible integration of various disciplines and educational tools, such as Baskin, into the teaching process.

Keywords: *Integrated Sport; Inclusive Physical Education; Innovations in Teaching*

Implementation of STEAM packages: Effects on teachers from the first educational cycle

Ivana Stepanović Ilić¹, Marina Videnović², Milana Dabić Boričić³

¹ *Department of Psychology, Faculty of Philosophy in Belgrade, Serbia*

² *Institute of Psychology, Faculty of Philosophy in Belgrade, Serbia*

³ *Faculty of Teacher Education, Belgrade, Serbia*

Abstract: This paper is part of the proSTEAM project, which focused on the development and piloting of STEAM teaching packages in the first cycle of education across four countries. Implementing these packages presents multiple challenges for teachers: on one hand, they are responsible for the correct application of materials and activities, including continuous monitoring of learning processes and encouraging students to engage in research and creative tasks; on the other hand, they must organize and coordinate group work, manage roles, and facilitate collaboration among students. The effects of STEAM package implementation on teachers were measured through changes in self-efficacy using the STEAM-TSES (STEAM Teacher self-efficacy scale), assessed before training and after package implementation. Additionally, interviews were conducted to explore teachers' experiences in applying the STEAM approach. The sample consisted of 29 teachers from primary schools in Belgrade who, after training, delivered 4–6 lessons using one of three pilot packages in Serbia: Symmetry (1st grade), Rainfall Measurement (3rd–4th grade), and Human Organ Systems. Results showed that teachers initially reported high STEAM-TSES scores, yet package implementation led to improvements in several subscales, particularly in chemistry, arts, and motivating students to engage in artistic activities. The main challenges reported by teachers were integrating STEAM activities into the existing curriculum and coordinating group work, while the greatest benefits involved increased student engagement and readiness to learn through STEAM. These findings provide a foundation for systematic implementation of the STEAM approach in the first cycle of education, emphasizing student motivation and the use of easily accessible, low-cost materials.

Keywords: *STEAM; Primary School Teachers; Self-Efficacy; STEAM-TSES Scale; Interviews*

Integration of Digital Educational Technologies and Student Motivation in Physical Education

Tamara Tonic¹

¹*University of Kragujevac, Faculty of Education, Jagodina, Serbia*

Abstract: Contemporary schooling faces the challenge of integrating digital educational technologies into physical education, which is particularly significant for student motivation and active participation. The aim of this paper is to analyze the possibilities of applying digital tools in physical education classes and their impact on student motivation. The sample of the study consists of relevant domestic and international research, as well as examples from teaching practice in lower primary school grades. The method applied is theoretical-analytical. The results of the review indicate that tools such as PowerPoint, Kahoot, WordWall, Scratch, InShot, and LearningApps enable active student participation, foster collaborative and competitive spirit, stimulate critical thinking, and contribute to the long-term acquisition of motor skills. Practical examples show that the use of digital technologies in lower grades leads to increased attention, curiosity, and persistence among students, as well as better understanding of teaching content. At the same time, challenges have been identified, such as insufficient digital literacy among teachers and the risk of reduced physical activity due to excessive use of technology. The conclusion is that digital educational technologies have great potential to improve physical education, provided that teachers act as facilitators of learning and apply digital tools in accordance with instructional goals. The pedagogical implication of the study is that technology should serve as a complement, rather than a substitute, for physical activity, and that continuous professional development of teachers in the field of digital literacy is essential.

Keywords: *Educational Technologies; Physical Education; Student Motivation; Active Learning; Interactive Learning*

Acquisition of Dialectological Vocabulary by Students

Milica Mitić¹

¹*University of Kragujevac, Faculty of Education, Jagodina, Serbia*

Abstract: This paper examines the acquisition of dialectal vocabulary among secondary school students, focusing on lexemes denoting female persons characterized by physical appearance or personality traits, extracted from the Dictionary of the Speech of Southern Serbia by Momčilo Zlatanović. The main aim of the research was to determine the extent to which students understand dialectal words that are rarely used in contemporary everyday communication, as well as to examine whether contextualization facilitates their comprehension. The research was conducted on a sample of 50 final-year students from a technical secondary school, including both urban and rural populations. The study was carried out in two phases. In the first phase, students were asked to interpret selected dialectal lexemes presented in isolation, without contextual support. In the second phase, the same lexemes were presented within sentence contexts, and students were required to interpret their meanings based on contextual clues. The research employed descriptive and statistical methods in the analysis of the collected data. The results indicate that students generally achieve a higher level of

comprehension when dialectal lexemes are presented in context. Furthermore, certain differences between students from urban and rural environments were observed, with rural students showing slightly better familiarity with specific lexemes; however, these differences were not consistent across all examples. The findings also suggest that lexemes with more transparent morphological structure and those closer to the standard language are more easily understood. This research highlights the importance of context in vocabulary acquisition and contributes to a broader understanding of the relationship between language, culture, and cognition in the process of learning.

Keywords: *Dialectal Vocabulary; Vocabulary Acquisition; Students; Context; Comprehension*

Unplugged Activities, Educational Robotics, or Screen-Based Applications? Slovenian Preschool Teachers' Preferences for Promoting Computational Thinking

Jakob Škrobar¹, Alenka Lipovec¹

¹ *University of Maribor, Faculty of Natural Sciences and Mathematics, Faculty of Education, Slovenia*

Abstract: Computational thinking (CT) is increasingly recognised as a key competence that should be developed from early childhood. Although previous studies have explored various ways to foster CT, limited evidence exists on preschool teachers' preferences regarding different teaching methods. This study aimed to investigate Slovenian preschool teachers' preferences for three common methods of promoting CT in early childhood education: screen-based applications, educational robotics, and unplugged activities. A cross-sectional survey design was employed, and a structured questionnaire was distributed to all kindergartens in Slovenia. The final sample included 448 preschool teachers. The results show that teachers perceive unplugged activities as the most meaningful and express the greatest willingness to implement them. Educational robotic kits were ranked second, while screen-based applications were viewed less favourably. These findings suggest that preschool teachers prefer hands-on, play-oriented learning experiences over digital ones. The study contributes to understanding how CT can be meaningfully integrated into preschool curricula and highlights the need for professional development and policy initiatives that align with teachers' pedagogical preferences.

Keywords: *Computational Thinking; Early Childhood Education; Preschool Teachers; Unplugged Activities; Educational Robotics*

Visualization of Rhythm in Music Education Through Dynamic Mathematical Models

Milan Milikić¹, Ivana Milić¹

¹ *University of Kragujevac, Faculty of Education, Jagodina, Serbia*

Abstract: The integration of curricular content represents one of the key challenges of contemporary teaching practice, particularly in the early grades of primary education. Connecting different sensory modalities, such as visual and auditory experiences, can

contribute to a deeper understanding of abstract concepts and the development of students' functional knowledge. This paper is based on the assumption that rhythmic structures in Music can be effectively interpreted through visual models grounded in simple geometric representations. In this context, the potential use of the dynamic mathematics software GeoGebra is considered as a tool for creating and interpreting rhythmic structures. Special emphasis is placed on designing learning activities in which students simultaneously perceive, represent, and analyze rhythm through interactive graphical representations. The aim of the paper is to present a model of integrative teaching in which the contents of mathematics and music are connected through concrete examples from classroom practice. Examples of tasks and activities will be presented that enable students to translate different rhythmic values into visual structures, thereby fostering an understanding of spatial relationships, sequence, and duration. Such an approach contributes to the development of interdisciplinary thinking, as well as to a more active role of students in the learning process, supported by the use of contemporary digital tools.

Keywords: *Integrative Teaching; Visualization of Rhythm; Music Education; GeoGebra; Mathematical Models*

Development of Computational and Mathematical Thinking in Early Childhood Education Using an Educational Robot

Milan Milikić¹, Aleksandar Milenković²

¹ *University of Kragujevac, Faculty of Education, Jagodina, Serbia*

² *University of Kragujevac, Faculty of Science and Mathematics, Department of Mathematics and Informatics*

Abstract: Many studies point to a trend of a declining number of professionals in STEAM fields, highlighting the importance of fostering interest and relevant competencies from an early age. Such activities gain additional value when preschool children are physically engaged in the learning process. This paper presents a workshop aimed at developing computational and mathematical thinking through STEPAM activities using the educational robot Bee-Bot, with the integration of physical activity of preschool children. The activities are based on movement across a square grid, where children first physically enact given paths while avoiding obstacles, and then transfer these strategies to programming the robot. The tasks involve determining a path from a starting to a target point under conditions of adjacency of cells of a square grid and set membership, thereby fostering the development of algorithmic thinking, understanding of spatial relations, and fundamental mathematical concepts. Focus is placed on connecting mathematical content with elements of knowledge about the environment. The cognitive levels of preschool children's activities are analyzed within the framework of APOS theory, with the aim of establishing a theoretical basis for monitoring the development of preschool children's thinking within this context.

Keywords: *Computational Thinking; Mathematical Thinking; Bee-Bot; STEPAM; APOS Theory*

Narrative as a Framework for STEP(A)M Activities – From The Conceited Peacock to Integrated Learning

Ivana Krulj¹, Aleksandra Mihajlović²

¹*The Academy of Applied Preschool Teaching and Health Studies, Department of Applied Preschool Teaching Studies, Aleksinac, Serbia*

²*University of Kragujevac, Faculty of Education, Jagodina, Serbia*

Abstract: The STEP(A)M approach in contemporary education promotes the integration of diverse domains of learning through meaningful contexts closely aligned with children's experiences. Narrative represents a valuable pedagogical framework for such integration, as it enables the connection of cognitive, creative, and socio-emotional dimensions of learning. The aim of this study is to examine how pre-service preschool and primary school teachers, drawing on the literary text *The Conceited Peacock*, design integrated STEP(A)M activities, and how they assess their own preparedness to implement this approach in their future professional practice. The study is designed as a descriptive-correlational investigation. Following the reading of the story, participants developed activities for children/pupils that are narratively and conceptually aligned with the text, with opportunities to incorporate various STEP(A)M components. Data were collected by an anonymous questionnaire and analyzed using descriptive statistics and correlation analysis. The findings are expected to indicate that participants recognize the potential of narrative as a starting point for integrated STEP(A)M learning. Artistic and scientific components are anticipated to be the most frequently integrated, whereas physical activities and technological elements may pose greater challenges. The results are expected to highlight the importance of systematically incorporating narrative-based approaches into initial teacher education.

Keywords: *STEP(A)M Approach; Narrative; Integrated Learning; Initial Teacher Education; Creative Planning*

STEAM Integration in Mathematics Education: Modeling the Optical Properties of the Parabola through Art Installation

Radoslav Božić¹

¹*Educons University, Faculty of Teacher Training, Novi Sad, Serbia*

Abstract: Contemporary mathematics education in secondary schools faces, among other problems, with the challenge of how to bring the abstract concepts of analytical geometry closer to the students, in an era dominated by algorithmic tools. This paper presents a didactic model based on the STEAM approach, which connects the mathematical theory of the conic sections, with an optics and aesthetic design. The central part of the work is the "Light Sculpture" problem, in which third-grade highschool students solve the problem of focusing sunlight using a parabolic mirror. The methodological framework of the paper relies on the concepts of mathematical intuition and guided discovery. During the learning process, the students pass through several stages, such as the intuitive prediction of ray paths, the formalization of parabola and tangent equations, and the discovery of the properties of parabola's focus, which represents the key point for the installation's artistic effect. Special emphasis is placed on the role of

artificial intelligence, as a tool for real-time simulation and error correction, with the note that technology should not replace the thought process but rather support creative research activity. The results of this approach indicate increased student motivation and a deeper understanding of the functional connection between mathematics and physics with art, as well as the other disciplines.

Keywords: *Art; Artificial Intelligence; Guided Discovery; Parabola; Steam Education*

Designing Interdisciplinary Project-Based Learning for Heterogeneous Groups

Carla Barreiros¹, Marjorie Da Cruz¹, Nelson Silva²

¹ *Interdisciplinary Transformation University, Center of Project-Based Learning, Austria*

² *Interdisciplinary Transformation University, Learning Innovations, Austria*

Abstract: When students from computer science, engineering, social sciences, and the arts are placed in the same project team, collaboration does not happen automatically. Differences in technical vocabulary, methodological assumptions, and academic conventions create friction that standard Project-Based Learning (PBL) designs rarely address. This paper presents a design-based research study conducted at IT:U (Interdisciplinary Transformation University) in Linz, Austria, where interdisciplinary project-integrated courses are central to the curriculum. Over two semesters, the study documents the iterative development of a ten-guideline framework for educators who design project courses for master's and doctoral students with different disciplinary preparation. The framework draws on Universal Design for Learning, Culturally Responsive Teaching, and collaborative learning research. Data sources include course design documentation from the institutional learning management system and structured educator reflections collected across two implementation cycles. Three design decisions emerged as relevant to interdisciplinary settings: intentionally composing teams along both disciplinary and demographic lines, making assessment criteria and expectations explicit from the outset, and providing differentiated support that addresses discipline-specific gaps rather than assuming a uniform level of preparation among students. The study is limited by its reliance on a single institutional context and on educator perspectives without direct student data. Future research should incorporate student experiences through interviews and surveys, examine learning outcomes across disciplines using assessment data, and test the framework in other interdisciplinary programs to assess whether the guidelines hold across different institutional structures and student populations. The paper offers a practical resource for educators working in interdisciplinary programs and contributes to the discussion of how integrative educational models, such as STEPAM, can be translated into concrete course design.

Keywords: *Interdisciplinary Project-Based Learning; Heterogeneous Groups; Design-Based Research; Higher Education, Collaborative Learning*

From Head to Toe: A Day of Discovery and Movement in Early Childhood Language Learning

Sandra Tasić¹

¹*University of Kragujevac, Faculty of Education, Jagodina, Serbia*

Abstract: The STEPAM paradigm-which integrates Physical Education- combined with Montessori principles and Content and Language Integrated Learning (CLIL) provides a holistic framework for early childhood language education. This case study investigates a one-day English language intervention with six preschool children aged 3–6 years. Four participants had prior language exposure from diverse contexts. Data were collected through observational notes, informal questioning, a pre-test administered prior to the intervention, and a post-test conducted one week later. Results indicate that all participants improved their understanding of the topic “Senses,” acquiring between five and fifteen new English vocabulary items. Instances of creative thinking and evidence-based reasoning in English were observed in two bilingual children. The findings suggest that young learners benefit from active, play-based, and movement-oriented learning combined with hands-on exploration. The study is limited by its small sample, short duration, and focus on short-term outcomes; therefore, the findings cannot be generalized beyond this specific context.

Keywords: *STEPAM; Montessori Method; CLIL; English Language Learning; Early Education*

Theoretical Contributions and Practical Challenges in the Reconceptualization of Early Learning through the STEPAM Approach

Daliborka Popović¹

¹ *State University in Novi Pazar, Novi Pazar, Serbia*

Abstract: Contemporary pedagogical paradigms in the field of early childhood education emphasize the need to reconceptualize early learning toward integrative, interdisciplinary, and experience-based approaches. Within this context, the STEPAM approach (science, technology, engineering, arts, and mathematics) is positioned as a relevant theoretical and methodological framework that enables the holistic development of the child and overcomes the disciplinary fragmentation of knowledge. The significance of the addressed issue lies in aligning educational practice with the demands of the contemporary knowledge society and fostering the development of transversal competencies. The aim of this paper is to critically analyze the theoretical scope of the STEPAM approach and to identify key challenges in its implementation within the process of reconceptualizing early learning. For the purpose of critically examining relevant theoretical frameworks and existing models of application, methods of theoretical analysis and a descriptive-interpretative approach were employed. The results indicate that the STEPAM approach enables the conceptual integration of different domains of learning, fosters knowledge construction through children’s active and inquiry-based engagement, and supports the development of creativity, critical thinking, and problem-oriented approaches. Additionally, the importance of the sociocultural context of learning is emphasized, as well as the role of the educator as a reflective practitioner and mediator in the process of knowledge co-construction. At the same time, challenges have been identified, including limited professional competencies

for interdisciplinary planning, insufficient curriculum flexibility, and resource constraints within the institutional context. It is concluded that the reconceptualization of early learning through the STEPAM approach requires a systemic and context-sensitive transformation of educational practice. Pedagogical implications point to the need for continuous professional development of educators, the advancement of reflective practice, and the creation of a stimulating, inquiry-oriented learning environment.

Keywords: *Integrative Learning; Inquiry-Based Learning; Holistic Development; Reflective Practice; Educators' Professional Competencies*

Development of Psychological Competencies Relevant to the Workplace through STEAM Education

Ensar Leković¹, Denis Demirović²

¹*State University in Novi Pazar, Novi Pazar, Serbia*

²*State University in Novi Pazar, Department of Philosophical Sciences, Study Program Psychology, Serbia*

Abstract: The contemporary work environment requires employees, in addition to digital literacy, to possess well-developed psychological competencies such as creativity, adaptability, and resilience. STEAM education, which integrates the Arts (A) into STEM disciplines, has been recognized as an approach with the potential to foster these skills. However, the relationship between STEAM-based learning outcomes and the specific needs of organizations has not yet been sufficiently examined within the framework of business psychology. The aim of this paper is to analyze and synthesize existing literature to determine how STEAM education contributes to workplace-relevant psychological competencies and their transfer into organizational contexts. A systematic literature review was conducted at the intersection of STEAM education and business psychology. The analysis indicates that STEAM methodology, through project-based and interdisciplinary learning, promotes the development of creativity, critical thinking, collaboration, and adaptability. These outcomes are closely related to key constructs in business psychology, such as psychological capital, growth mindset, and psychological safety, which are well-established predictors of innovativeness and team effectiveness in organizations. STEAM education represents a relevant framework for developing psychological competencies necessary for professional success in the 21st century. Pedagogical implications emphasize aligning curricula with labor market demands and valuing these competencies in personnel selection and development processes.

Keywords: *STEAM; STEM; Education; Competency Development*

Between Screens and Movement: The Role of Mass Media in Shaping Youth Physical Activity in Leisure Time

Biljana Popeska¹, Despina Sivevska¹

¹ Goce Delcev University, Faculty of Educational Sciences, North Macedonia

Abstract: Leisure time represents a key context for the development of healthy lifestyles, particularly among children and adolescents, where habits related to physical activity (PA), social interaction, and well-being are established. In contemporary society, mass media plays a significant role in shaping daily routines, behaviors, and attitudes, potentially influencing the quality of leisure time and levels of PA among youth. However, increased media consumption is often associated with sedentary behavior, raising concerns about its long-term effects on health and well-being. The aim of this study was to examine the influence of mass media on PA levels and the quality of leisure time among youth, as well as to explore their perceptions and attitudes regarding media use and active lifestyle engagement. The study included a sample of 206 respondents aged 15 years and older. Data were collected using a specially designed online questionnaire, administered individually under the supervision of the research team between September and October 2025. The questionnaire included socio-demographic variables (age, gender, place of residence, education level, and access to mass media) as well as closed-ended items measured on a Likert-type scale assessing agreement and satisfaction with statements related to media use and physical activity. All responses were collected anonymously to ensure confidentiality. Data were analyzed using SPSS software. Descriptive statistics were applied to summarize the data, while independent samples t-tests were used to identify significant differences between age groups. Results were additionally presented in graphical form for clearer interpretation. Findings indicate that mass media plays a significant role in shaping youth leisure-time behavior, with notable associations between media exposure and reduced PA levels. The results highlight differences across age groups in media use patterns and activity engagement. The study emphasizes the need for educational and preventive strategies aimed at promoting balanced media consumption and encouraging more active and health-oriented leisure time among young people.

Keywords: *Physical Activity; Leisure Time; Lifestyle; Media Influence*

Dancing with Physics: Design-Based Research as a Framework for Developing a Physics Embodying Learning Lab

Abril Armenta Franco¹, Eva Ulbrich¹, Zsolt Lavicza¹

¹ Johannes Kepler Universität, Austria

Abstract: This paper presents the methodological journey of designing and iterating a Physics Embodying Learning Lab — a STEAM-based learning environment where secondary school students explore physics concepts through the sensorial experience of dance. Using Design-Based Research (DBR) as the guiding methodology, the lab has undergone five iterative cycles through the JKU Science Holidays (2022–2025), each informing the next through observation, video recording, and dialogue analysis. Key design challenges encountered across iterations include language barriers, student energy management, the need for dance knowledge, and the

gradual expansion of physics topics from classical mechanics to optics. This paper reflects on how DBR enabled a responsive and evolving design process and discusses the methodological decisions that shaped each cycle. The next phase — implementing the lab at the Freie Waldorfschule Graz and a traditional school with high school students, focused on thermodynamics — will provide new data to further refine the design. Findings suggest that DBR is a powerful framework for developing embodied, arts-integrated science learning environments.

Keywords: *Design-Based Research; Embodied Learning; Physics Education; Dance in Education*

From MOOC to Motion: Experiencing and Designing STEPAM-Based Embodied Learning Activities with Pre- and In-Service Teachers

Abril Armenta Franco¹, Guillermo Bautista Jr.¹, Zsolt Lavicza¹

¹ *Johannes Kepler Universität, Austria*

Abstract: Rising rates of sedentary behaviour and childhood obesity present a growing challenge for contemporary education systems. Rather than addressing this through additional physical education hours, the STEPAM framework (Science, Technology, Engineering, Physical Activities, Arts & Mathematics) proposes integrating physical activity and embodied learning directly into STEM lessons. This paper reports on two international teacher training experiences aimed at introducing pre- and in-service teachers to the STEPAM framework and enabling them to experience and design embodied learning activities, drawing on a 36-lesson Massive Open Online Course (MOOC) compiled on GeoGebra as part of the Erasmus+ project Teacher Training in Physical Activities and Embodied Learning through STEAM Education, with lesson units developed collaboratively by partner institutions from Serbia, Finland, and Austria. The first experience took place during a Blended Intensive Programme (BIP) in the Czech Republic, where a 90-minute workshop was conducted with 26 pre- and in-service teachers of Mathematics, Chemistry, and Physics from Czech Republic, Finland, Austria, and other countries. Participants first engaged in three hands-on MOOC activities: a high-intensity movement energiser; an embodied narrative enacting the physical evolution of the human species from *Driopithecus* to *Homo sapiens*; and a blended activity combining embodied exploration of the circumference of a circle with consolidation in GeoGebra. Subsequently, approximately six groups of five to six participants each designed and presented their own short STEPAM-based activities in Mathematics and Chemistry, situating their proposals within the framework's taxonomy by specifying physical intensity and whether the activity aimed to activate learners through movement or to encode knowledge through embodiment, gesture, and physical characterisation. Selected examples of participant-designed activities are described to illustrate how the framework was interpreted across subject areas. The second experience consisted of a webinar delivered to approximately 150 pre-service teachers in the Philippines, where the STEPAM framework and selected MOOC lessons were introduced; one participant independently extended an existing MOOC lesson into a new activity integrating English language learning and spatial vocabulary. Across both contexts, facilitators observed high levels of engagement and enjoyment. Many participants expressed surprise at the feasibility of integrating physical activity and embodiment into STEM lessons. The BIP participants' ability to independently design and classify STEPAM activities suggests that even brief, structured

exposure to the framework can foster meaningful transfer into teachers' pedagogical thinking. These findings have implications for the design of scalable, MOOC-based teacher professional development within interdisciplinary, movement-integrated approaches to STEM education.

Keywords: *STEPAM; Embodied Learning; Physical Activity; Teacher Training; Geogebra MOOC; STEAM Education*

Integration of Digital Technologies in the STEPAM Approach as a Model of Contemporary Preschool Education

Marija Krstić Radojković¹

¹*University of Kragujevac, Faculty of Education, Jagodina, Serbia*

Abstract: The STEAM approach in early childhood education is increasingly recognized as a response to the need for integrated learning that connects inquiry, creativity, movement, and problem solving into meaningful wholes. Within this context, this paper examines the role of digital technologies as resources for planning, implementing, and documenting STEAM activities in preschool education. The aim of the study is to explore how digital tools support STEAM activities and the development of children's competencies through integrated tasks. The sample comprises children from a preparatory preschool group affiliated with Primary School "Vasa Pelagić" and the Preschool Institution "Vukica Mitrović" in Leskovac, included in a case study of the project "We at the Museum." A case study methodology was employed, drawing on an analysis of planned activities and learning products, as well as insights from systematic observations conducted by educators. The findings indicate that digital technologies play multiple roles within the STEAM approach—from providing stimuli and resources for inquiry, to supporting communication and collaborative learning, to enabling creative production and checking understanding. In practice, this is reflected in access to diverse prompts, peer communication and collaboration, and the creation of digital products such as quizzes, presentations, and simple digital didactic games. A contribution was observed in the development of digital literacy, critical thinking, creativity, and communication skills, as well as in strengthening connections among areas of knowledge within integrated STEAM tasks. The conclusions suggest that high-quality integration of digital technologies within the STEAM approach requires clearly structured activities and continuous pedagogical guidance to ensure that digital tools remain in the service of learning. The pedagogical implications point to the need to develop practitioners' methodological and digital competencies and to design integrated tasks that enable active and meaningful learning in preschool education.

Keywords: *STEAM; Integrated Learning; Early Childhood Education; Preschool Education; Collaborative Learning*

The Effects of Gamification and Exergaming in Physical Education in Primary School - Review Article

Ana J. Lilić¹, Sara, J. Perković², Stefan M. Mijalković², Nikola S. Prvulović³

¹University of Kragujevac, Faculty of Education, Jagodina, Serbia

²Faculty of Sport and Physical Education, University of Niš, Serbia

³Centre of Research Excellence in Nutrition and Metabolism, Institute for Medical Research, National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia

Abstract: The aim of this study was to review and critically examine the existing evidence on the effects of gamification and exergaming in physical education in primary school. A systematic search was conducted in PubMed and Web of Science for studies published between 2010 to 2025. Seven studies met the eligibility criteria and were included in the final synthesis, comprising a total of 985 participants of both sexes aged 6 to 14 years. The included studies varied considerably in design, sample size, intervention duration and frequency, program content, and outcome measures. Overall, the analyzed studies suggest that gamification and exergaming may have positive effects on students' intrinsic motivation, enjoyment, engagement, and selected educational outcomes in physical education classes. In several studies, these approaches were also associated with improvements in basic psychological needs, flow, and academic performance, although the sustainability of these effects appears to depend on the quality and duration of implementation. Despite the generally promising findings, methodological heterogeneity and practical limitations such as resource availability and teacher workload should be taken into account when interpreting the results. It can be concluded that gamification and exergaming represent potentially valuable pedagogical strategies in primary school physical education, but further methodologically robust research is needed to clarify their long-term educational effectiveness.

Keywords: *Motivation; Physical Activity; Active Learning*

Primary School Students' Perceptions and Attitudes Toward STEPAM Approach?

Olivera Cekić Jovanović¹, Aleksandra Mihajlović¹, Aleksandar Ignjatović¹

¹University of Kragujevac, Faculty of Education, Jagodina, Serbia

Abstract: Physical inactivity among children has become a major global public health concern, with more than 80% of adolescents failing to meet recommended physical activity guidelines. Schools provide one of the few structured settings for promoting regular physical activity; however, physical education often represents the only organised form of activity during school hours and remains limited in duration. At the same time, concerns have emerged regarding low achievement and participation in STEM-related fields, creating a need for innovative educational approaches. Integrated STEM/STEAM learning has been recognised as a promising strategy for developing key competencies and increasing student engagement. While previous studies have explored children's attitudes toward physical activity, limited research has examined perceptions of interdisciplinary approaches combining STEM and movement. Therefore, this study aimed to examine primary school students' perceptions and attitudes toward STEPAM activities. The research was conducted in 2025 and included a sample of 79 fourth-grade primary school students from Jagodina, Serbia. Students completed a questionnaire evaluating their experiences with STEPAM lessons. The results revealed generally positive perceptions of the implemented activities, with mean scores ranging from

4.08 to 4.47 on a five-point scale, indicating a high level of agreement with positive statements. The highest score was recorded for inquiry-based activities ($M = 4.47$, $SD = 0.60$), while similarly high ratings were observed for enjoyment and engagement-related items ($M = 4.37$, $SD = 0.77$). Overall, students evaluated STEPAM lessons very positively.

Keywords: *Physical Activity; STEAM Education; Student Engagement*

Language Acquisition Through Music and Movement

Jelena Spasić¹, Nataša Vukićević¹

¹*University of Kragujevac, Faculty of Education, Jagodina, Serbia*

Abstract: The preschool period represents the most intense phase of children's language and musical development. These two aspects of development occur in parallel, suggesting the application of related content and approaches in early education. Building on the findings that the first forms of children's singing precede the speech period, as well as numerous analogies between language and music, this paper explores the possibilities of language acquisition through music and movement. Movement, in this context, serves as a didactic tool that mediates between music and language, facilitates the integration of diverse areas, content, and abilities, and promotes rapid and effortless language acquisition.

Keywords: *Language Development; Music; Movement; Integration; Preschool Age*

A Systematic Review of Physical Activity Integration in STEAM Education: Pedagogical Approaches, Learning Outcomes, and PA-STEAM Framework

Josephine Lau¹, Aleksandar Ignjatović², Marjorie Cristina Da Cruz³, Olivera Cekić-Jovanović², Kristóf Fenyvesi¹, Zsolt Lavicza⁴

¹*Finnish Institute of Educational Research, University of Jyväskylä, Finland*

²*University of Kragujevac, Faculty of Education, Jagodina, Serbia*

³*Interdisciplinary Transformation University, Austria*

⁴*School of Education, Johannes Kepler University of Linz, Austria*

Abstract: Significance and Context of the problem: Highlighting the limited synthesis of physical activity (PA) integration in K–12 STEAM education, this systematic review examines an emerging interdisciplinary approach linking embodied learning and academic outcomes. Objectives: The objective was to analyze how PA is incorporated across STEAM subjects and to synthesize reported outcomes. Sample and methods: Following PRISMA 2020 guidelines, 45 peer-reviewed empirical studies (2010–2025) from Web of Science and SPORTDiscus were included. Two independent reviewers extracted and analyzed data on study characteristics, intervention types, and outcomes, with over 90% agreement. Results: Results show most studies were conducted in Europe and North America, primarily in primary education, with mathematics most frequently integrated and engineering underrepresented. Quantitative methods dominated, and interventions mainly involved PA-integrated learning and technology-enhanced physical education. Findings indicate improvements in physical wellbeing, STEM knowledge acquisition, classroom engagement, and student motivation. Conclusion: Based on these results, the PA-STE(A)M framework is proposed, linking intervention types

with outcome profiles. In conclusion, although the field is expanding, it remains uneven, with gaps in engineering integration, longitudinal research, and secondary education. Educational implications: The study emphasizes the need for more balanced, transdisciplinary, and sustainable approaches to integrating PA in STEAM to support both learning and wellbeing.

Keywords: *Embodied Learning; Interdisciplinary Curriculum; K-12; Physical Education Pedagogies; STEAM Education Integration*

Does Physical Education and Health Belong in STEM? A Meta-Analysis of STEPAM Integration Effects

Muhammet Usak¹

¹*University of Kragujevac, Faculty of Education, Jagodina, Serbia*

Abstract: Physical education and health (PEH) has often been a peripheral discipline in curriculum reform, largely excluded from influential STEM (Science, Technology, Engineering, and Mathematics) frameworks. The STEPAM framework was proposed to integrate PEH into STEM, yet it remains unclear whether this integration is empirically supported or merely theoretical. Although STEPAM research is methodologically diverse, studies on integrating science, health, and physical education lack cumulative synthesis. Findings remain scattered across disciplines, preventing the identification of meaningful patterns through quantitative aggregation. This meta-analysis addresses this gap by systematically collecting and statistically synthesizing experimental and quasi-experimental studies that implemented a STEPAM or STEM-PEH integrated approach and measured its effects on student outcomes. The primary objective was to determine whether STEPAM integration yields measurable improvements in cognitive outcomes (science and mathematics), motor skill development, physical activity levels, and health literacy. It also examined whether effect sizes differ based on moderators like age group, educational level, intervention duration, instructional model, or country. A systematic search of Web of Science, Scopus, PubMed, SPORTDiscus, and ProQuest Dissertations was conducted for English-language publications from 2005 to 2025. Studies required an experimental/quasi-experimental design with a comparison group, explicit integration of PEH with a STEM discipline, and sufficient statistical data. Two researchers independently coded each eligible study. Effect sizes, calculated as Hedges' *g*, were analyzed using a random-effects model. Moderator analyses were performed through meta-regression and subgroup comparisons.

Keywords: *STEPAM Integration; STEM; Physical Education; Health; Meta-Analysis; Science Education*

A pilot Acceptance and Commitment training program's effect on college students

Luca Pump¹, Zoltán Kiss¹

¹*Eötvös József College, Institute of Pedagogy, Hungary*

Abstract: This study aimed to examine differences in self-evaluative outcomes across groups with varying levels of sport participation within the context of the Acceptance and Commitment training program. Participants were categorized into three groups: non-athletes, recreational (hobby-level) athletes, and competitive athletes. Participants were recruited from a Hungarian college as a free chosen course. The training was delivered by an ACT trainer. The training consisted of 4, 8-hour meeting. A longitudinal repeated measure design was used, the participants filled 3 times the questionnaires out (before, during and after the training). Participants engaging in physical activity (both recreational and competitive) demonstrated slightly higher mean scores compared to non-athletes ($\Delta M \approx 0.2\text{--}0.3$), although the magnitude of these differences suggests a modest effect size. Descriptive statistics further indicated that recreational athletes achieved the highest average scores, followed closely by competitive athletes, while non-athletes consistently reported the lowest values. These findings highlight the positive association between sport participation and self-evaluative outcomes. Even moderate levels of physical activity appear to be linked to more favorable self-perceptions, suggesting that engagement in sport—regardless of intensity—may play a meaningful role in supporting psychological development. The results underscore the importance of promoting physical activity not only for physical health but also for its potential benefits in enhancing self-awareness and personal growth.

Keywords: *ACT Program; College Students; Physical Activity; Mental Health*

STEM in Mathematics Education in Vietnam: Real-World Problem Contexts, Interdisciplinary Knowledge Integration, and Mathematical Problem-Solving Competency

Duc Lan Do¹

¹*The Vietnam Institute of Educational Sciences, Vietnam*

Abstract: The STEM approach in mathematics education in Vietnam has gained increasing attention within the competency-based orientation of the 2018 General Education Curriculum. Recent international studies emphasize that mathematics should not be marginalised in integrated STEM education; rather, it should function as a core disciplinary and modelling tool for interpreting, representing and solving complex real-world. Research on STEM-based problem solving highlights the centrality of mathematical modelling, critical thinking, systems thinking and design-based thinking, while recent studies on inquiry-oriented STEM learning further suggest that meaningful STEM tasks require students to formulate, test and refine mathematical models rather than merely solve contextualized textbook exercises. In Vietnam, emerging studies show growing interest in designing STEM-oriented mathematics lessons, including topics such as equations, geometry in practice and primary mathematics. However, implementation remains uneven. Three key issues can be identified. First, the mathematics curriculum is increasingly oriented toward practical problems, yet many classroom tasks risk becoming superficial “real-world” word problems without authentic modelling demands.

Second, STEM is sometimes interpreted as adding content from physics, chemistry or biology into mathematics lessons, which may overload teachers and weaken the mathematical focus. Third, STEM is often associated narrowly with problem-solving competence, although the mathematics curriculum defines a broader set of competencies, including mathematical reasoning, modelling, communication, problem solving and the use of tools. This paper argues that STEM in mathematics education should be reframed around mathematical modelling as the central process. Rather than integrating additional subject content, STEM should integrate authentic problems that activate multiple mathematical competencies. This requires stronger task design, teacher professional development and assessment practices that value reasoning, modelling and solution justification.

Keywords: *STEM Education; Mathematics Education; Mathematical Modelling; Problem Solving; Vietnam; Competency-Based Curriculum.*

Encouraging Children's Development through the Integration of STEM and Early English Language Learning in the Transition from Kindergarten to School

Mira Jovanović¹, Sanja Vuletić¹, Nataša Dubljanin¹

¹Academy of Vocational Studies, Šabac, Department of Preschool Teachers and Nurse Preschool Teachers, Serbia

Abstract: The purpose of this paper is to present examples of good practice in encouraging children's development through the integration of STEM and early English language learning during the transition from kindergarten to primary school. The aim was to introduce preschool children in the transitional period to STEM concepts, while integrating terminology that is also used in English, in order to expand children's vocabulary in that language. Transition is defined as a set of processes that involve a child's movement from a preschool institution to primary school, the child's attempts to adapt to different expectations, and the ways in which preschool teachers and primary school teachers prepare children for this transition. The transition process is grounded in the strengths of each child, which is essential for fostering the holistic development of personality. The STEM approach is particularly natural for children, as it provides opportunities for active learning and knowledge acquisition, while encouraging the development of operational and critical thinking, self-evaluation, the strengthening of a positive self-image, respect for diverse ideas and approaches to problem-solving, as well as collaboration across different domains. The essence of the STEM approach lies in asking stimulating questions, fostering innovation, and encouraging creativity. In addition, the STEM approach supports the development of children's verbal abilities. Preschool teachers and English language teachers implemented STEM experiments within an integrated approach and through project-based planning in kindergartens, using natural materials and materials from the immediate environment. Through the project-based approach and children's active participation in STEM activities combined with English language learning, children were enabled to explore a wide range of project topics, which contributed to the expansion of their vocabulary in both English and their mother tongue. We believe that research with this focus can contribute to forming a clearer view of current practice and the effects of encouraging children's development through the integration of STEM and early English language learning in the transition process.

implemented by preschool teachers and English language teachers from kindergarten to primary school.

Keywords: *STEM; Early English Language Learning; Integration; Transition*

Implementing the STEM approach in the education of Preschool and Early School Pedagogy students

Katarzyna Ziembakowska-Cecot¹

¹*Casimir Pulaski Radom University, Faculty of Philology and Pedagogy, Department of Pedagogy, Poland*

Abstract: The article discusses creative activities undertaken in the education of Preschool and Early School Pedagogy students at the University of Radom in order to implement the STEM approach. It points out the importance of developing creative and innovative attitudes in teacher trainees and pupils, as well as the need to design and implement classes using activating didactic methods, experiments or the research station method. It presents some practices, cooperation with local schools and educational institutions, and stages of implementing coding and robotics classes. The article also emphasizes the role of appropriate preparation of students to work with students with diverse needs and the need to develop their digital competences. Although these activities require organizational involvement and support, they bring benefits in the form of increased student motivation and effective implementation of the STEM concept in early school education.

Keywords: *STEM; Student Education; Elementary Education; Creative Activities*

Multisensory and Interdisciplinary Learning as a Foundation for STEAM Education: A Montessori Pedagogical Perspective

Marija Lesandrić¹, Ana Mirosavljević¹

¹*Sveučilište u Slavonskom Brodu, Odjel društveno-humanističkih znanosti, Odsjek za izobrazbu učitelja i odgojitelja, Croatia*

Abstract: Multisensory and interdisciplinary learning is widely recognised as a foundation of contemporary STEAM education; however, traditional classroom instruction remains largely fragmented and insufficiently experiential. Montessori pedagogy offers a theoretically grounded and practice-validated framework that integrates multisensory stimulation, inquiry-based learning, and a holistic curriculum, yet its contribution to the development of STEAM education in traditional primary classrooms has not been sufficiently investigated. This study aimed to examine how elements of Montessori pedagogy can support multisensory and interdisciplinary learning and contribute to the development of STEAM competencies in traditional classroom contexts. The study used a qualitative action research approach and involved primary school teachers (N=20) participating in an online Montessori teacher learning community and their students. Data were collected through interviews, classroom observations, and reflective records, and were analysed using thematic analysis. The findings indicate that

the implementation of specific Montessori didactic materials, a prepared learning environment, and an active, facilitative teacher role enables students to engage multiple senses simultaneously when learning mathematics, science, social studies, language, and the arts. This approach supports the understanding of abstract concepts through concrete experience, strengthens cross-curricular connections, and fosters the development of critical thinking, problem-solving, creativity, and learner autonomy. In conclusion, Montessori pedagogy provides a coherent framework for the development of high-quality and sustainable STEAM education in primary classrooms, and the systematic integration of Montessori elements into everyday teaching practice is recommended.

Keywords: *Didactic Materials; Interdisciplinarity; Montessori Pedagogy; Multisensory Learning; STEAM Education*

Music as the “Arts” Component in the STEAM Model: An Analysis of Science Festival Activities (2017–2025)

Zrinka Šimunović¹

¹*Odsjek za izobrazbu učitelja i odgojitelja, Sveučilište u Slavonskom Brodu, Croatia*

Abstract: Science festivals are key venues for non-formal education and the STEAM approach. Since 2003, the Science Festival in Croatia, under the auspices of the Ministry of Science and Education, with co-financing from other public institutions and societies, has actively promoted these goals. This paper explores the interactive role of music within festival programs from 2017 to 2025, viewing it as a vital "Arts" component within the STEAM model. The objective is to identify and analyze activities involving active child participation—such as workshops and performances—focusing on their pedagogical potential and outcomes. The research is descriptive-analytical, employing qualitative content analysis of a sample comprising all festival programs from the specified period. Data collection involved archival analysis of official websites and multimedia materials. Results systematize frequency trends and typologies of music activities through a thematic matrix, while synthesizing pedagogical patterns. Implications suggest that integrating interactive musical elements into science popularization is essential for developing interdisciplinary STEAM strategies.

Keywords: *Science Festival; STEAM Approach; Music Pedagogy; Interactive Learning; Non-Formal Education*

Enhancing EFL Listening Through STEPAM-Based Instruction: Effects on Comprehension, Strategy Use, and Student Engagement

Marijana Matic¹

¹*FILUM, University of Kragujevac, Serbia*

Abstract: This study explores the effectiveness of a STEPAM-based listening approach in teaching English as a Foreign Language (EFL) at the tertiary level. Unlike traditional listening instruction, which primarily focuses on comprehension accuracy, the STEPAM model integrates listening with problem-solving, interdisciplinary content, and process-oriented

learning. The aim of the study is to examine whether embedding listening tasks within authentic, problem-based activities enhances students' listening comprehension, strategy use, and engagement. The research included an experimental group exposed to STEPAM-based listening tasks and a control group receiving conventional instruction. Data was collected through pre- and post-listening tests, strategy-use questionnaires, and student reflections. The results indicate that the experimental group achieved significantly higher results in listening comprehension and demonstrated increased use of metacognitive strategies. Students also reported higher levels of engagement and perceived the tasks much more useful. The findings suggest that STEPAM-based listening offers a promising alternative to traditional approaches by promoting deeper cognitive processing and meaningful language use.

Keywords: *STEPAM Approach; Listening Comprehension; EFL; Task-Based Learning; Listening Strategies; Student Engagement*

The Impact of School Physical Education on Fulfilling WHO Physical Activity Recommendations for Children and Adolescents

Badriya AL-Hadabi¹

¹*Sultan Qaboos University, Oman*

Abstract: Regular physical activity is widely recognized as a fundamental component of healthy growth and development in children and adolescents. Participation in moderate-to-vigorous physical activity contributes significantly to improving cardiovascular fitness, muscular strength, bone health, psychological well-being, cognitive performance, and social interaction. In contrast, physical inactivity and sedentary behavior are associated with increased risks of obesity, diabetes, cardiovascular diseases, and other non-communicable diseases that have become major global public health concerns. According to the World Health Organization (WHO), children and adolescents should engage in at least 60 minutes of moderate-to-vigorous physical activity daily to achieve optimal health benefits. Despite the established health benefits of physical activity, global evidence indicates that a large proportion of young people fail to meet the recommended activity levels. Contemporary lifestyles characterized by excessive screen time, reduced outdoor play, and increased sedentary behavior have contributed to declining physical activity levels among school-aged populations worldwide. Schools therefore represent one of the most effective environments for promoting active lifestyles, as they provide structured opportunities for movement through physical education classes, recess, and extracurricular activities. This study highlights the importance of school-based physical activity in supporting children and adolescents to achieve international health recommendations. The research focuses on assessing levels of moderate- to-vigorous physical activity and sedentary behavior among school students using scientifically validated objective measurement tools, particularly accelerometers. Furthermore, the study examines the influence of factors such as gender and weight status on students' activity patterns during physical education lessons. The findings emphasize the critical role of school physical education in reducing sedentary behavior and enhancing daily physical activity levels. Strengthening school-based interventions and promoting active lifestyles among children are essential strategies for improving public health outcomes and achieving global physical activity targets.

Keywords: *Physical Activity; School-Based Physical Education; Sedentary Behavior*



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