Each year, FIEPS publishes a specialized book collection featuring contributions from scholars, experts, and university professors on pressing issues within physical education and sport. This collaborative project is a core part of the organization's mission.

The series began in 2017 with "Physical Education in Primary School: Researches - Best Practices - Situation," which was edited by D. Collela, B. Antala, and S. Epifani. That 502-page book, published by Pensa Multimedia in Italy, featured 102 authors from 27 countries across five continents.

This year's volume has a new title, "Bridging Theory and Practice in Physical Education: Researches, Curriculum and Teacher Training" reflecting a specific and narrow topic. The following questions guided the contributions and were intended to be answered through country reports:

Research

- Has research been conducted in your country on the role of theoretical knowledge in promoting physical activity?
- Have studies assessed students' theoretical understanding within Physical Education (PE)?
- Have interventions been designed to integrate theoretical knowledge to increase physical activity among children or adults?

Curriculum

- Does your country's PE curriculum include theoretical content? If so, what content and topics are included, and at which educational levels are they taught?
- Does the curriculum require teachers to evaluate students' theoretical knowledge?
- Are students assessed and graded on their theoretical understanding, or only on their practical skills and performance?

Teacher Training

- Are prospective PE teachers trained to deliver theoretical content?
- Beyond methods for teaching practical skills, are they taught strategies for imparting theoretical knowledge?
- If a PE textbook is available, how are teachers trained to use it effectively in their instruction?

With 96 authors from 22 countries across 5 continents, the book offers a truly global perspective. The contributors hail from Europe, the Americas, Asia and Oceania, ensuring a wide-ranging and inclusive examination of the topic.

Editors

ISBN 978-606-527-737-3

Bridging Theory and Practice in Physical Education
Research - Curriculum - Teacher Training

Editors:
Gabriela Luptáková
Branislav Antala
Gheorghe Balint
Marek Lazar
Dario Novak
Ionut Dantis

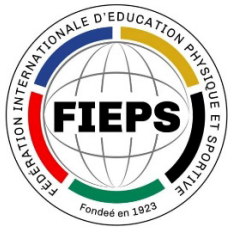
Bridging Theory and Practice in Physical Education Research - Curriculum - Teacher Training



SCIENCE OF SPORT AND PHYSICAL EDUCATION COLLECTION

EDITURA „ALMA MATER"
BACĂU, 2025

FÉDÉRATION INTERNATIONALE D´ÉDUCATION PHYSIQUE
ET SPORTIVE



Bridging Theory and Practice in Physical Education

Researches – Curriculum – Teacher Training

Editors:

Gabriela Luptáková
Branislav Antala
Gheorghe Balint
Marek Lazar
Dario Novak
Ionut Dantis

EDITURA „ALMA MATER"
BACĂU, 2025

Comparative Perspectives on Integrating Physical Activity and STEAM in Austria, Serbia, and Finland: A Policy Framework for Interdisciplinary Learning and the STEPAM Initiative.

Marjorie Da Cruz [1] – Josephine Lau [2] – Aleksandra Mihajlović [3] – Kristóf Fenyvesi [1,4] – Zsolt Lavicza [1] – Aleksandar Ignjatović [3]

[1] Johannes Kepler University Linz (JKU), Austria
[2] Finnish Institute for Educational Research, University of Jyväskylä; Finland
[3] University of Kragujevac, Faculty of Education in Jagodina, Serbia
[4] Global Research Institute for Finnish Education, The Education University of Hong Kong, Hong Kong, SAR China.

e-mail: aleksig79@yahoo.com

Abstract

This paper presents a comparative analysis of policies integrating physical activity (PA) and Science, Technology, Engineering, Arts, and Mathematics (STEAM) education in primary and lower secondary schooling across Austria, Serbia, and Finland. The study also introduces and contextualizes the STEPAM (Teacher Training in Physical Activities and Embodied Learning through STEAM Education) project as a response to identified needs in fostering such interdisciplinary connections. This analysis highlights existing strengths and prevailing challenges within current cross-disciplinary education models using curriculum documents, teacher training requirements, and pertinent research. Findings suggest that while all three nations recognize the importance of holistic student development, significant differences in infrastructure, teacher training paradigms, and curriculum design create varied opportunities for interdisciplinary learning. Consequently, policy recommendations, informed by the STEPAM model principles, are proposed to strengthen equity, enhance teacher capacity, and stimulate innovation in integrating Physical Education (PE) and STEAM.

Key words: Physical Education; STEAM Education; Interdisciplinary Learning; Curriculum Policy; Comparative Analysis; STEPAM; Embodied Learning; Teacher Training for STEAM.

Introduction

Contextualizing PE-STEAM Integration and the STEPAM Initiative

Physical Education (PE) is a component of many educational systems, contributing to physical health, mental well-being, social competencies, and cognitive development. Despite its importance, PE approaches vary across educational systems, reflecting different resource levels, pedagogical philosophies, and cultural contexts.

In Europe, Austria, Serbia, and Finland present different models for organizing PE, offering examples of how national priorities, infrastructure, and educational values shape the subject. PE policies in European countries are influenced by European Union recommendations and national priorities (Council of the European Union, 2013). Varied cultural, economic, and historical backgrounds in Europe have led to systems ranging from structured, skill-focused curricula to holistic, learner-centered frameworks (Kirk, 2009). Austria uses a structured PE curriculum, Serbia is modernizing its PE framework amidst challenges, and Finland is known for a student-centered educational philosophy that promotes physical activity holistically.

While these educational systems emphasize student development, including health and social-emotional growth, divergence exists in their approaches to teacher preparation, safety standards, and, for this paper, cross-curricular connections with Science, Technology, Engineering, Art, and Mathematics (STEAM) education. Integrating PE with STEAM subjects is an area with potential for enhancing learning, yet it is often underdeveloped in policy and practice. This gap is a focus of the present analysis.

This comparative analysis addresses theoretical and practical concerns. Theoretically, it examines how cultural, economic, and social factors influence PE policy and its interdisciplinary potential. Practically, it aims to identify practices that could inform educational development. The STEPAM (Teacher Training in Physical Activities and Embodied Learning through STEAM Education) project is an initiative in this context. STEPAM aims to improve teacher training programs, equipping educators with skills and pedagogical approaches to integrate physical activity effectively and embodied learning strategies with STEAM subjects. This paper compares national policies and uses insights relevant to STEPAM's objectives to explore how such a project can address challenges in PE-STEAM integration. Integrating STEPAM's principles into teacher education could resolve the disconnect between PE and academic subjects, fostering a synergistic learning experience.

The study examines national curricula for students aged seven to fourteen in Austria, Serbia, and Finland, focusing on teacher training, safety protocols, and PE integration with academic goals like STEAM education. While after-school activities influence physical activity, the focus is on formal, curriculum-based PE during school hours, where policy interventions can have a broad societal impact. Articulating the underutilization of PE's potential for STEAM learning and introducing STEPAM as a framework provides a solution-oriented rather than a merely descriptive narrative.

This paper will outline the theoretical framework connecting PE and STEAM, followed by the methodology for the comparative analysis. Subsequent sections will describe the national PE landscapes in Austria, Serbia, and Finland, focusing on existing or potential PE-STEAM links and teacher training. A comparative synthesis will highlight commonalities, divergences, and gaps. The STEPAM project and its model will then be elaborated, showing its potential as a catalyst for interdisciplinary teacher training. The discussion will propose a unified policy framework informed by the comparative findings and STEPAM principles. Finally, organizational structures and collaborative opportunities will be explored, leading to conclusions and future directions.

Theoretical Framework: Bridging PE and STEAM through the STEPAM Lens

To conceptualize the link between Physical Education and STEAM education, Figure 1 presents an adapted framework in which Motor and Cognitive Skills, Cross-Disciplinary Integration, and the Learning Environment interact within a broader Educational Context, emphasizing Inclusive and Equitable

Participation, Assessment, and Adaptation (adapted from Quigley et al., 2020). In this adapted version, the overlapping circles represent (a) Motor and Cognitive Skills, (b) Cross-Disciplinary Integration, and (c) Learning Environment. These elements are within an overarching Educational Context that prioritizes Inclusive & Equitable Participation and robust Assessment & Adaptation mechanisms.

This adapted framework resonates deeply with, and can be seen to inform, the core principles of the STEPAM project. STEPAM's emphasis on "Physical Activities and Embodied Learning through STEAM Education" provides a practical means to operationalize the interactions depicted in Figure 1. Embodied learning, a central tenet of the STEPAM approach, posits that cognitive processes are deeply rooted in the body's interactions with the world. This perspective strengthens the connection between the "Motor and Cognitive Skills" and "Cross-Disciplinary Integration" domains. For instance, when students learn physics concepts (STEAM) through carefully designed physical movements or explore geometric principles (STEAM) by creating shapes with their bodies (PA), embodied learning acts as the pedagogical bridge. This approach moves beyond merely juxtaposing PE and STEAM to fostering a truly integrated learning experience where physical action enhances conceptual understanding and vice versa. The STEPAM model, therefore, seeks to equip teachers with the pedagogical tools to design learning experiences that leverage this powerful integration.

By situating Physical Education in dialogue with STEAM components, the figure highlights potential pathways for teachers, administrators, and policymakers to create more holistic and interdisciplinary PE programs that reinforce physical competencies and academic skills (Metsäpelto & Pulkkinen, 2012). Technologies such as "Active Science," which link activity tracking to STEM learning tasks, represent promising avenues for such integration (Riley et al., 2014). When viewed through the STEPAM lens, the framework illustrates theoretical connections and points towards actionable strategies for teacher training and curriculum development. It underscores the potential for PE to become a vibrant context for applied STEAM learning, moving students from abstract concepts to concrete, physically experienced understanding. This conceptual grounding is vital, as it demonstrates that the STEPAM initiative is not an isolated endeavor but is built upon established educational theories regarding the benefits of interdisciplinary and embodied approaches to learning. STEPAM addresses the challenge of translating this theoretical potential into widespread, effective classroom practice.

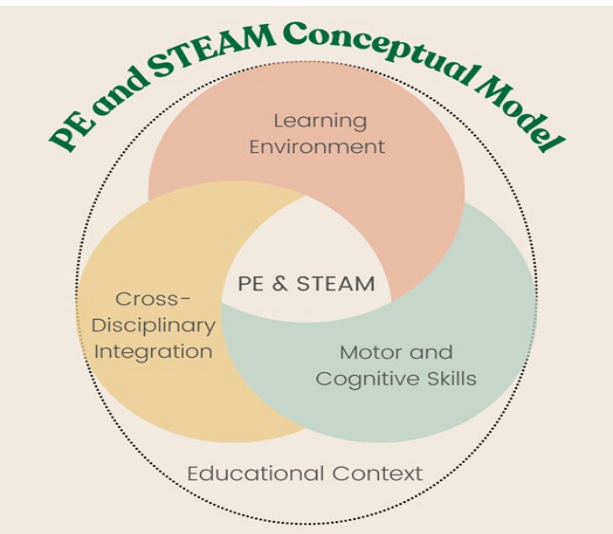


Figure 1. Adapted Conceptual Model Bridging PE and STEAM (inspired by Quigley et al. 2020).

These observations suggest ample opportunities for cross-national policy learning and convergence. Aligning reliable teacher training, adequate infrastructure, cross-curricular connections, and minimum weekly PE time could foster more equitable and impactful physical education across Europe.

Methodology for Comparative Policy Analysis

A systematic approach was employed to compare PE in Austria, Serbia, and Finland, accounting for political, cultural, and socio-economic dimensions that shape educational policies and practices (Bray & Thomas, 1995). This comparative methodology allows for a nuanced understanding of how different national contexts influence the integration of PE and STEAM. The disorganization that can arise from presenting methodological details sporadically through a paper is avoided by consolidating this information into a coherent section, thereby enhancing clarity for the reader.

The research drew from several key data sources:

- **Primary Policy Documents:** These documents provide each country's official stance and regulatory framework for PE.
  - **Austria:** Key documents include the Verordnung der Bundesministerin für Unterricht, Kunst und Kultur über die Lehrpläne der Volksschule (BGBl. II Nr. 303/2012) and the Verordnung über die Lehrpläne für die Neue Mittelschule (BGBl. II Nr. 185/2012) (BMBWF, 2012a, 2012b). These legislative acts govern the curriculum at the primary and lower secondary levels, respectively.
  - **Serbia:** A series of rulebooks issued between 2017 and 2019 specify PE hours, objectives, and teaching methods for primary education (Rulebook, 2017, 2018, 2019).
  - **Finland:** The foundational document is the National Core Curriculum for Basic Education 2014 (Finnish National Board of Education, 2014).
- **Research Literature:** A review of scholarly articles was conducted using databases such as ERIC, SPORTDiscus, and Web of Science. The search focused on publications from 2010 to 2020 (with consideration for more recent literature where relevant to the STEPAM project's current context) addressing curriculum design, teacher training, inclusive practices, safety standards, and PE-STEAM integration.
- **NGO and Organizational Reports:** Reports from international bodies like UNESCO (e.g., Quality Physical Education Guidelines for Policymakers, 2015), WHO (e.g., Global Recommendations on Physical Activity for Health, 2010), and the Council of Europe provided international benchmarks and recommendations for child physical activity and inclusive PE.
- **Theoretical Interviews:** While no actual interviews were conducted for this specific Paper, the analysis considered what experts (policymakers, teacher educators, PE teachers) would likely highlight, serving as conceptual triangulation to ensure a comprehensive perspective.

The analytical process involved a textual content analysis of the primary policy documents. These documents were systematically examined for explicit statements and implicit indications related to several key themes: aims and objectives of PE, allocated instructional time, core content areas, safety guidelines (including teacher-student ratios where specified), provisions for cross-curricular STEAM integration, the degree of teacher autonomy, assessment criteria, and policies promoting equity and inclusion. Information extracted on these themes was organized into comparative matrices to identify commonalities, divergences, best practices, and areas for potential improvement across the three national systems. This structured data extraction and analysis approach ensures the credibility of the findings and provides a solid foundation for the subsequent discussion and recommendations.

National Landscapes: PE and STEAM Integration in Austria, Serbia, and Finland

The following sections delve into the specific contexts of Physical Education in Austria, Serbia, and Finland, examining their curricula, the extent of PE-STEAM integration, teacher training systems, and inherent strengths and challenges. This detailed country-by-country analysis is crucial for understanding the diverse starting points from which any unified policy or collaborative initiative like STEPAM must operate.

AUSTRIA

PE Curriculum and Context

In Austria, Physical Education, termed "Bewegung und Sport" (Movement and Sport), is governed by national frameworks issued by the Bundesministerium für Bildung, Wissenschaft und Forschung (BMBWF), although significant implementation variations occur at the federal state (Bundesland) level. PE in primary education (Volksschule) typically involves two to three hours per week, emphasizing developing motor skills, healthy lifestyles, and fair play (BMBWF, 2012a). At the lower secondary level (Neue Mittelschule), PE continues with around two hours per week, often balancing sports-based instruction with broader developmental goals (BMBWF, 2012b). Austria's PE framework evolved from late 19th and early 20th-century Central European gymnastics movements, initially emphasizing discipline and national identity (Grabner, 2018). Over time, policy shifted towards a more holistic model, mirroring global discourses on physical activity's mental, emotional, and social facets. The Austrian curriculum now emphasizes competence-based learning, targeting physical literacy, social skills, and health promotion. However, regional disparities in instructional time, facility quality, and emphasis on cross-curricular links persist, impacting uniform implementation.

PE-STEAM Links

Despite the holistic aspirations, explicit interdisciplinary integration with STEAM subjects is limited within the Austrian PE curriculum. Although general cross-curricular collaboration is encouraged in policy documents, systematic frameworks or specific guidelines detailing how PE could be linked with mathematics, science, or technology remain underdeveloped. Crucially, STEAM as a holistic, integrated concept is not explicitly mentioned in the current PE curricula (BMBWF, 2012a, 2012b). This lack of explicit guidance means that any PE-STEAM integration often depends on individual teacher initiative rather than systemic support.

Teacher Training for PE (and PE-STEAM)

Teacher preparation for PE in Austria varies. Primary school teachers typically receive generalist training, with basic modules in physical education included during their initial teacher education programs. PE is often taught by subject specialists who undertake additional certifications for lower secondary education. However, considerable variability remains across the federal states, particularly regarding specialist qualifications, ongoing professional development opportunities, and training in cross-curricular or interdisciplinary teaching methodologies relevant to PE-STEAM integration.

Strengths and Challenges

Austria's strengths lie in its structured, competence-based PE framework and a policy shift towards holistic development. Challenges include regional disparities in implementation, the lack of formalized PE-STEAM links in the curriculum, and variability in teacher training for interdisciplinary approaches. The existing policy-practice gap, where national guidelines are not uniformly applied, suggests a need for more robust mechanisms to ensure consistency and support for innovative practices like PE-STEAM integration.

SERBIA

PE Curriculum and Context

Physical education in Serbia has drawn upon diverse European influences, notably the Sokol movement, German gymnastics (Turnen), and Swedish systematic exercises (Ilić & Mijatović, 2006). Serbia's recent path has been shaped by its post-socialist transition, blending older traditions with contemporary frameworks. The PE curriculum for primary education has undergone modernization since 2017, with the adoption of a series of rulebooks outlining reforms for grades 1–4 (Rulebook, 2017, 2018, 2019). Students typically engage in three 45-minute weekly sessions, focusing on fundamental movement skills, modern sports activities, rhythmic exercises, and health education. The Serbian curriculum stresses

physical development, health maintenance, and social-emotional learning, including promoting fair play and the inclusion of students with disabilities. A recent innovation is the introduction of "polygon activities"—flexible, obstacle-course-based sessions.

PE-STEAM Links

These "polygon activities" could theoretically integrate mathematical (e.g., measuring distances, counting repetitions) or linguistic competencies (e.g., following complex instructions). However, the curriculum currently provides limited structured guidance or explicit pedagogical strategies for formal STEAM connections. The potential for interdisciplinary learning exists, but it is not yet systematically developed or supported within the official framework.

Teacher Training for PE (and PE-STEAM)

Initial teacher education for primary school generalists in Serbia includes basic PE instruction. However, continuous professional development opportunities, especially those focused on modern pedagogical approaches or interdisciplinary teaching, remain limited and unevenly distributed across the country. Efforts have been made to introduce more structured in-service training to address updated curriculum goals, but resource constraints frequently hinder comprehensive implementation.

Strengths and Challenges

Serbia strongly intends to modernize its PE curriculum, with reforms introducing potentially flexible activities. However, several structural and resource challenges persist. The quality of infrastructure, equipment availability, and teacher preparation consistency vary widely across regions, affecting the uniform application of curricular goals. These resource limitations significantly hinder fully realizing the curriculum's interdisciplinary potential, including PE-STEAM integration. The gap between policy aspiration (modernization) and practical reality (resource constraints) is a key issue.

FINLAND

PE Curriculum and Context

Finland's National Core Curriculum for Basic Education (2014) offers a comprehensive, student-centered approach to PE, rooted in the broader educational principle of fostering holistic well-being (Finnish National Board of Education, 2014). PE instruction typically involves approximately two weekly lessons in grades 1–4 and increases to two to three weekly lessons in grades 5–9, complemented by mandatory daily recess periods that promote physical activity. Finnish PE aims to develop motor skills, healthy lifestyles, autonomy, cooperation, and a positive self-image. A hallmark of the Finnish system is its phenomenon-based learning model, which encourages exploring real-world phenomena through an interdisciplinary lens (Halinen, 2018).

PE-STEAM Links

Finland's curriculum explicitly encourages interdisciplinary connections, especially through its phenomenon-based learning model. PE lessons are regularly linked with mathematics (e.g., measuring distances, calculating scores, understanding angles in movement), science (e.g., biomechanics of movement, physiological responses to exercise), and arts (e.g., dance, rhythm exercises, creative movement). Research suggests that physical activity engagement enhances motor skills and academic achievement in the Finnish context (Metsäpelto & Pulkkinen, 2012). This provides a concrete example of how PE-STEAM integration can be structurally embedded within a national curriculum.

Teacher Training for PE (and PE-STEAM)

Finland boasts a highly regarded teacher education system. Primary teachers (grades 1-6) receive extensive, research-based education; specialist PE teachers are required for grades 7–9. Teacher education programs emphasize teacher autonomy, social-emotional learning, inclusion, phenomenon-based learning, and interdisciplinary approaches (Lanas & Kiilakoski, 2013). This includes preparing teachers to

integrate PE with other subjects. Finland's system promotes reflective practice and continuous professional growth through municipally supported programs and national networks, regularly updated based on new pedagogical and scientific research (Sahlberg, 2015). The commitment to inclusive education is well-established, ensuring PE aims to cater to students with diverse learning needs and abilities, a principle reinforced in teacher training and curriculum guidelines.

Strengths and Challenges

Finland's strengths are numerous: a student-centered, holistic curriculum; explicit support for interdisciplinary learning through phenomenon-based approaches; and a robust, research-informed teacher education system that fosters autonomy and prepares educators for interdisciplinary work. However, even within this highly effective system, challenges related to local resource variation and consistency of implementation across municipalities can persist. While a strength, teacher autonomy can also lead to variability in how deeply cross-curricular connections are embedded in practice.

Comparative Synthesis: Commonalities, Divergences, and Gaps in PE-STEAM Integration

Across Austria, Serbia, and Finland, national curricula unequivocally recognize the pivotal role of Physical Education in fostering physical health, social skills, and overall personal development. This shared acknowledgment provides a common foundation. However, beyond this general agreement, significant divergences emerge, particularly concerning the explicit integration of PE with STEAM subjects, the pedagogical approaches employed, the nature and focus of teacher training, and the consistency of resource support and implementation.

The degree of explicit PE-STEAM integration varies markedly. Finland stands out with its phenomenon-based learning model, which structurally encourages and supports linking PE with subjects like mathematics, science, and arts. This contrasts sharply with Austria, where PE-STEAM integration is generally limited to an encouragement of cross-curricular activities without systematic frameworks or specific curricular mandates for STEAM. Serbia, with its recent modernization efforts and introduction of "polygon activities," shows nascent potential for such integration, but this remains largely underdeveloped due to a lack of detailed guidance and resource constraints.

Teacher training for interdisciplinary teaching also presents a key point of divergence. Finland's system places a strong emphasis on preparing teachers for interdisciplinary work, supported by research-based education and teacher autonomy. In Austria and Serbia, while basic PE instruction is part of teacher education, specialized training for integrating PE with STEAM is less common and more variable, often hampered by systemic limitations or lack of focused professional development programs.

Curriculum structure and flexibility further differentiate the three countries. Finland's model is characterized by high teacher autonomy and the flexible framework of phenomenon-based learning. Austria employs a more structured, competence-based curriculum, but implementation can vary significantly across its federal states. Serbia is in a phase of modernizing its curriculum, which aims for increased flexibility, but its successful rollout is heavily dependent on overcoming substantial resource and infrastructure challenges. These systemic differences in educational philosophy, resource allocation priorities, and teacher development infrastructure create distinct barriers and opportunities for PE-STEAM integration.

Consequently, several critical gaps hinder the effective and widespread integration of PE and STEAM. These include:

- A lack of specific, evidence-based pedagogical models for PE-STEAM integration outside of Finland's phenomenon-based approach.
- Insufficient and inconsistent teacher training in designing and implementing interdisciplinary PE-STEAM lessons.
- Resource inequities, particularly in Serbia and parts of Austria, that limit access to necessary

facilities, equipment, and professional development.

- A policy-practice gap in several instances, where the aspirational goals of curricula are not fully realized due to implementation challenges.

While Finland offers a compelling model, its direct replication in other contexts is challenging without addressing these underlying systemic differences. This underscores the need for adaptable solutions and targeted interventions, such as those envisioned by the STEPAM project, which can be tailored to diverse national and local contexts to build teacher capacity for innovative PE-STEAM practices. The following table provides a summarized comparison.

Table 1. Comparative Matrix of PE and STEAM Integration Policies

Feature	Austria	Serbia	Finland
National PE Policy/Curriculum Document	BMBWF Curricula (2012a, 2012b)	Rulebooks for Primary Education (2017-2019)	National Core Curriculum for Basic Education (2014)
Mandated PE Hours (Primary/Lower Secondary)	Primary: 2-3 hrs/week; Lower Secondary: ~2 hrs/week	Primary: 3x45-min sessions/week	Primary (1-4): ~2 lessons/week; Lower Secondary (5-9): 2-3 lessons/week (+ daily recess)
Stated PE Goals	Motor skills, healthy lifestyles, fair play, competence-based learning, social skills, health promotion.	Fundamental movement, sports, health education, physical development, social-emotional learning, inclusion.	Motor skills, healthy lifestyles, autonomy, cooperation, positive self-image, holistic well-being.
Explicit STEAM/Cross-Disciplinary Links in PE Curriculum	Limited; general encouragement for cross-curricular work, but no systematic STEAM frameworks.	Potential in "polygon activities" for math/language; limited structured guidance for formal STEAM connections.	Explicitly encouraged, especially via phenomenon-based learning (links to math, science, arts).
Dominant Pedagogical Approaches for PE-STEAM (if any)	Primarily individual teacher initiative if pursued.	Nascent, through flexible "polygon activities"; lacks defined pedagogical models for STEAM.	Phenomenon-based learning as a key interdisciplinary approach.
Teacher Training Model for PE	Primary: generalist training with PE modules. Lower Secondary: subject specialists. Variable by state.	Primary: basic PE in generalist training. Limited continuous professional development.	Primary: extensive research-based generalist training. Grades 7-9: specialist PE teachers. Strong emphasis on autonomy & research.
Specific Training for PE-STEAM Integration	Limited and variable; not a standard component of teacher education or professional development.	Very limited; hindered by resource constraints and lack of systematic programs.	Integrated into broader training on interdisciplinary approaches and phenome-based learning.

Key Strengths for PE-STEAM	Structured curriculum with holistic aims; potential for competence-based links.	Modernization drive; introduction of flexible activity formats ("polygon activities").	Explicit curricular support for interdisciplinarity; strong, research-based teacher education; phenomenon-based learning model.
Key Challenges for PE-STEAM	Lack of explicit STEAM frameworks; regional implementation disparities; variable teacher training.	Significant resource/infrastructure gaps; limited teacher training for interdisciplinarity; lack of detailed guidance.	Ensuring consistent implementation across municipalities; potential for variability due to high teacher autonomy.

The STEPAM Project: A Catalyst for Interdisciplinary Teacher Training and Embodied Learning in PE-STEAM

The comparative analysis of PE and STEAM integration in Austria, Serbia, and Finland reveals a clear need for enhanced teacher preparedness and innovative pedagogical models. It is precisely to address these needs that the STEPAM (Teacher Training in Physical Activities and Embodied Learning through STEAM Education) project was conceived. As an initiative co-funded by the European Union under the ERASMUS+ Programme (Grant No. 2023-1-RS01-KA220-HED-000166894), STEPAM's overarching goal is to develop, implement, and disseminate innovative teacher training programs. These programs are designed to equip educators at various levels with the competencies required to integrate physical activity effectively and embodied learning methodologies with STEAM subjects, thereby fostering a more holistic and engaging learning experience for students. The project's collaborative, European dimension underscores its potential for cross-national learning and impact.

The rationale for STEPAM is directly rooted in the gaps identified in the preceding country analyses. Across the compared nations, and indeed more broadly, there is often a disconnect between the recognized potential of interdisciplinary learning and the practical ability of teachers to implement it effectively, particularly at the intersection of PE and STEAM. STEPAM aims to bridge this gap by addressing:

- The lack of teacher preparedness in designing and delivering integrated PE-STEAM lessons.
- There is a need for concrete, adaptable pedagogical models that go beyond general encouragement for cross-curricular activities.
- The desire to leverage physical activity not just for physical health, but as a powerful tool for enhancing cognitive engagement and conceptual understanding in STEAM disciplines.

The STEPAM model is built upon several key pillars and principles, designed to provide a comprehensive approach to teacher development in this area:

- **Embodied Learning as a Core Pedagogy:** This is central to the STEPAM philosophy. Embodied learning emphasizes that thinking and learning are not purely abstract mental processes but are deeply intertwined with physical experience and interaction with the environment. In the context of PE-STEAM, this means designing activities where students physically enact, explore, or model scientific concepts, mathematical principles, engineering designs, or artistic expressions. For example, students might learn about forces and motion (Physics/Engineering) by analyzing their own movements in different sports, explore geometric transformations (Mathematics) by creating sequences of body shapes, or use programmable robots (Technology) to perform physically choreographed tasks (Arts).

- **Interdisciplinary Curriculum Modules:** STEPAM focuses on developing practical, evidence-based training modules and resources for teachers. These modules aim to provide educators with both the theoretical understanding and the practical tools to design, implement, and assess integrated PE-STEAM learning experiences. They are likely to include sample lesson plans, activity ideas, and guidance on adapting content to diverse student needs and local contexts.
- **Focus on Teacher Competencies:** The project seeks to build a specific set of competencies in teachers. These include the ability to identify meaningful connections between PE and STEAM learning objectives, design coherent interdisciplinary units, utilize appropriate technologies to support PE-STEAM activities (such as sensors for data collection during physical tasks, or simulation software), employ diverse assessment strategies that capture both physical and cognitive learning, and create inclusive learning environments where all students can participate and succeed in embodied PE-STEAM activities.
- **Collaborative and Practice-Oriented Approach:** Recognizing that sustainable change in teaching practice often comes from peer learning and hands-on experience, STEPAM likely incorporates collaborative elements such as communities of practice, school-based action research, or peer coaching. This allows teachers to share experiences, co-develop resources, and receive constructive feedback as they experiment with new pedagogical approaches.
- **Technology Integration:** Where appropriate, the STEPAM model encourages the thoughtful integration of digital tools and technologies that can enhance embodied learning and facilitate PE-STEAM connections. This could range from simple apps for motion analysis or data logging to more complex tools like wearable sensors (akin to the "Active Science" concept) or virtual reality environments that allow for novel forms of physical interaction with digital content.

The STEPAM model offers tangible ways to address the unique challenges and leverage opportunities in each of the three compared countries:

- **Austria:** STEPAM training could provide Austrian teachers with the specific pedagogical strategies and curriculum development skills needed to move beyond general encouragement for cross-curricular work towards more systematic and impactful PE-STEAM integration. It could help bridge the gap between the competence-based curriculum's aims and practical classroom implementation of interdisciplinary activities.
- **Serbia:** For Serbia, STEPAM can offer targeted professional development that supports the pedagogical enrichment of "polygon activities" and other PE elements, explicitly linking them to STEAM learning outcomes. By focusing on innovative, potentially low-cost teaching strategies that leverage embodied learning principles, STEPAM could help build teacher capacity even in contexts with infrastructure limitations.
- **Finland:** While Finland already has a strong foundation with phenomenon-based learning, STEPAM could further enrich this by introducing novel perspectives on embodied cognition, offering specific tools and techniques for PE-STEAM activities, and providing frameworks for systematically sharing successful embodied learning practices across municipalities, thereby helping to address local variations in implementation.

The anticipated outcomes of the STEPAM project are multifaceted. For teachers, it promises increased confidence and competence in designing and delivering innovative interdisciplinary lessons. For students, it offers the potential for increased engagement and motivation in both PE and STEAM subjects, deeper conceptual understanding through embodied experiences, and the development of 21st-century skills such as critical thinking, creativity, and collaboration. At a systemic level, STEPAM aims to contribute to the development of more holistic, relevant, and effective education systems by promoting a culture of interdisciplinary collaboration and pedagogical innovation. The project thus serves not only as a research

subject but as an active intervention designed to catalyze positive change.

Table 2. Overview of the STEPAM Project Model and its Application

STEPAM Model Component	Description/Objective	Illustrative Application/Relevance to Austria, Serbia, Finland
Core Principle: Embodied Learning	Emphasizes learning through physical action and sensory experience to deepen conceptual understanding in STEAM.	**All countries:** Training teachers to design activities where students physically model scientific principles (e.g., levers in Austria), solve math problems through movement patterns (e.g., angles in Serbia), or express artistic concepts through dance/gymnastics (e.g., symmetry in Finland).
Core Principle: Interdisciplinary Module Design	Development of practical, adaptable training modules and resources for integrated PE-STEAM lessons.	**Austria:** Providing templates for linking "Bewegung und Sport" competencies with specific STEAM learning goals. **Serbia:** Offering low-cost, high-impact module ideas for enriching "polygon activities" with explicit STEAM content. **Finland:** Supplementing phenomenon-based learning with specific embodied strategies for diverse STEAM topics.
Teacher Competency Focus: Designing Integrated Lessons	Equipping teachers to identify authentic connections and plan coherent PE-STEAM learning sequences.	**All countries:** Workshops on curriculum mapping to find overlaps between PE objectives and STEAM standards, fostering co-planning between PE and classroom teachers.
Teacher Competency Focus: Technology for PE-STEAM	Training in using relevant technologies (sensors, apps, simulations) to enhance embodied learning and data analysis.	**Austria/Serbia:** Introducing accessible tools for motion analysis or data collection during PE to connect with math/science. **Finland:** Exploring advanced simulations or VR for novel embodied STEAM experiences.
Teacher Competency Focus: Inclusive Pedagogy	Ensuring PE-STEAM activities are accessible and engaging for all students, regardless of ability or background.	**All countries:** Strategies for differentiating embodied tasks, adapting equipment, and fostering collaborative group work in diverse classrooms.
Approach: Collaborative Professional Development	Fostering communities of practice, peer learning, and school-based experimentation.	**All countries:** Establishing networks for teachers to share successful PE-STEAM lessons, troubleshoot challenges, and co-create resources, potentially leveraging STEPAM's international partnerships.

Discussion

Pathways to Enhanced PE-STEAM Integration through a Unified Policy Framework Informed by STEPAM

The comparative analysis of Physical Education policies in Austria, Serbia, and Finland, coupled with an understanding of the challenges and opportunities for PE-STEAM integration, underscores the need for a more harmonized approach. The following discussion outlines key pillars for a unified policy framework, explicitly demonstrating how such a framework can be informed and strengthened by the principles and potential of the STEPAM project. This approach seeks to move beyond identifying problems to proposing actionable, evidence-informed solutions.

Pillar 1: Policy Integration & Minimum Standards

A foundational element is the integration of clear, consistent guidelines for PE-STEAM into national or even supranational educational policies. This involves establishing baseline curricular objectives for PE that explicitly include interdisciplinary connections with STEAM, defining core teacher competencies for delivering such integrated instruction, and ensuring adequate resource allocation. The STEPAM project, with its focus on developing teacher competencies in embodied learning and interdisciplinary PE-STEAM pedagogy, can directly inform the definition of these standards. For instance, competencies cultivated through STEPAM training such as designing integrated learning units or using technology to bridge PE and STEAM could become benchmarks for teacher certification or professional development pathways.

Pillar 2: Aligned Educational Philosophy

Effective PE-STEAM integration requires an educational philosophy that is child-centered, inclusive, and holistic, prioritizing students' physical, cognitive, mental, and social well-being. This means moving PE beyond a purely skills-based or recreational activity to recognize its potential as a rich context for applied learning across disciplines. STEPAM's emphasis on embodied learning aligns perfectly with this philosophy. Embodied cognition theories suggest that learning is most effective when it engages the whole person. By training teachers to create learning experiences where students physically engage with abstract STEAM concepts, STEPAM promotes a pedagogy that is inherently holistic and student-centered.

Pillar 3: Curriculum Standardization with Flexibility & STEPAM Content

A unified framework should aim to standardize core learning outcomes for PE-STEAM integration such as fundamental motor skills, health literacy, basic scientific inquiry skills applied in physical contexts, mathematical reasoning through movement, and creative expression via physical activity. However, this standardization must be balanced with flexibility to allow for local adaptation, incorporating culturally relevant activities or addressing specific community needs. STEPAM-developed curriculum modules and pedagogical approaches can serve as valuable resources here. These modules could provide a "common core" of PE-STEAM activities and teaching strategies that can then be adapted by teachers in Austria, Serbia, and Finland to fit their specific curricula and student populations, ensuring both consistency in quality and local relevance.

Pillar 4: Teacher Education & Professional Development - STEPAM's Core

This is arguably the most critical pillar, where STEPAM's contribution is most direct and impactful. A unified policy must mandate robust pre-service and in-service teacher education on PE-STEAM integration. This includes:

- **Pre-service training:** Incorporating dedicated modules on interdisciplinary pedagogy, embodied learning principles, and the practicalities of designing PE-STEAM lessons into initial teacher education programs for both generalist primary teachers and specialist PE teachers.
- **In-service professional development:** Offering ongoing, high-quality professional development opportunities, modeled on STEPAM's approach, allows practicing teachers to acquire and refine the skills needed for effective PE-STEAM instruction. This could involve workshops, coaching, and participation in professional learning communities. Minimum hours for PE-related pedagogical training, including interdisciplinary approaches, could be mandated for primary generalists, with advanced certifications available for those specializing in PE-STEAM at the lower secondary level. STEPAM can serve as a model for such professional development programs and a source of validated training materials.

Pillar 5: Monitoring & Evaluation

A system for monitoring and evaluating PE-STEAM integration is essential to ensure effectiveness and drive continuous improvement. This involves collecting data on student outcomes (e.g., physical fitness,

motor skill proficiency, engagement in PE and STEAM, understanding of STEAM concepts learned through embodied methods) and teacher practices. The impact of STEPAM-like interventions can be assessed through research on teacher confidence, changes in pedagogical approaches, and student learning gains. Periodic policy reviews, informed by this data, would allow for iterative framework refinement.

Implications for Austria, Serbia, and Finland - Revisited through the STEPAM Lens:

Austria: Adopting elements of the STEPAM model could help Austrian educators move from general encouragement of cross-curricular links to the systematic development and implementation of concrete PE-STEAM lessons. STEPAM training could provide the pedagogical tools to operationalize the competence-based curriculum in an interdisciplinary fashion.

Serbia: STEPAM's focus on teacher capacity building and adaptable pedagogical models (including low-cost, high-impact strategies) could be particularly beneficial for Serbia. It could provide the necessary support to enrich "polygon activities" with explicit STEAM content and help overcome some of the challenges posed by infrastructure limitations by empowering teachers with innovative teaching methods.

Finland: For Finland, STEPAM could offer new perspectives on embodied learning to enrich its already strong phenomenon-based projects further. It could also provide a platform for codifying and disseminating best practices in PE-STEAM integration more widely across municipalities, potentially helping reduce local variations and further strengthening Finland's holistic education leadership.

Benefits and Challenges of a Unified Approach:

The potential benefits of such a unified, STEPAM-informed policy framework are significant. They include greater consistency in the quality of PE-STEAM education, enhanced teacher capacity and confidence (particularly through shared resources and training models like STEPAM's), and a potential integration of health and academic outcomes for students. Such an approach could also foster greater international collaboration and recognition. However, challenges will undoubtedly arise. Tensions may exist between national autonomy and centralized directives (e.g., Finland's high teacher autonomy versus more standardized approaches). Resource discrepancies, especially in Serbia, remain a major hurdle. Cultural resistance to new pedagogical approaches or perceived increases in teacher workload must also be anticipated and addressed. However, STEPAM's collaborative, multi-national nature may help navigate some of these challenges by fostering dialogue, sharing solutions, and demonstrating the practical benefits of PE-STEAM integration through pilot programs and teacher networks.

Organizational Structures and Collaborative Opportunities for PE-STEAM (Leveraging STEPAM)

The effective implementation of PE-STEAM integration, as envisioned through a unified policy framework and initiatives like STEPAM, depends critically on well-aligned organizational structures and robust collaborative mechanisms. Physical education in Austria, Serbia, and Finland operates within complex multi-level governance systems, encompassing national ministries or educational boards (e.g., Austria's BMBWF, Serbia's Ministry of Education, Finland's National Board of Education), regional and local authorities, school administrations, and classroom teachers. International organizations like UNESCO, WHO, and the European Commission also play a role by offering guidelines, funding, and frameworks that can support cross-border policy harmonization.

Despite these existing structures, persistent challenges can hinder effective PE-STEAM integration. In Austria, coordinating federal guidelines across diverse states can lead to resource allocation and program implementation variations. In Serbia, infrastructure shortfalls and inconsistent local budgets often complicate the rollout of new policies and the provision of continuous professional development. Even in Finland, with its highly decentralized system, municipal priorities and resource variations can lead to inconsistencies in how PE and interdisciplinary learning are implemented. A collaborative, multi-partner

project like STEPAM, which inherently involves stakeholders from different countries and institutional levels (universities, schools, potentially policymakers), can play a vital role in bridging some of these structural gaps. It can facilitate communication, promote the sharing of best practices, and pilot innovative solutions that can then be scaled up or adapted by national systems.

Strategies for better organizational alignment, infused with the potential of STEPAM, include:

- **School Administrators:** Principals and school management teams are crucial in creating supportive environments. This includes ensuring access to fundamental facilities and safe equipment, protecting instructional time for PE, and actively encouraging and enabling teachers to participate in STEPAM-related training or to implement STEPAM methodologies in their classrooms. They can champion interdisciplinary collaboration within their schools.
- **Teacher Training Institutions:** Universities and colleges responsible for initial teacher education and continuous professional development are key partners. Institutions involved in the STEPAM project can lead in disseminating the project's model and findings. Collaborative programs, such as those facilitated by Erasmus+, can further enhance the sharing of evidence-based methods for PE-STEAM integration. Curricula within these institutions should be updated to reflect the importance of embodied learning and interdisciplinary skills.
- **Curriculum Development Bodies:** National and regional bodies responsible for curriculum design should actively seek to incorporate embodied learning principles and explicit PE-STEAM connections, drawing on models and resources developed by projects like STEPAM. The integration of technology, such as the "Active Science" concept, where activity tracking is linked to STEM learning, should be considered, with STEPAM providing pedagogical frameworks for its effective use.

The STEPAM project exemplifies cross-country cooperation as a mechanism for advancing PE-STEAM integration. **STEPAM can serve as a model or a nucleus for broader collaborative efforts, such as:**

- **A Collective Monitoring Body:** A cross-national group, evolving from STEPAM stakeholders, could monitor progress in PE-STEAM policy implementation, promote the exchange of best practices, and suggest evidence-based revisions to policies and programs.
- **Teacher Exchange Programs and Joint Research:** Facilitating opportunities for teachers and researchers from Austria, Serbia, and Finland (and beyond) to visit each other's institutions, observe practices, and collaborate on research projects can accelerate learning and innovation. STEPAM's network can be a starting point for such exchanges.
- **Shared Resource Platforms:** Developing and maintaining online platforms for sharing STEPAM-developed training materials, lesson plans, and research findings can ensure wider access and sustained impact.

An illustrative example of how STEPAM can facilitate practical implementation is the adaptation of the "Active Science" approach. STEPAM training would equip teachers in Austria, Serbia, and Finland with the pedagogical skills to effectively design and implement such activities within their unique national contexts.

For instance:

In Austria, teachers trained through STEPAM could design lessons where students use accelerometers to collect data on their movement during different physical activities (e.g., running, jumping, specific sports skills). They could then use this data in mathematics lessons to calculate speeds, distances, energy expenditure, or in science lessons to understand biomechanical principles. This would align with the competence-based curriculum by providing authentic contexts for applying skills.

In Serbia, where modernization is a key goal but resources may be limited, STEPAM could focus on training teachers to use readily available technology (like smartphones with motion sensors) or even low-tech methods (e.g., manual timing and measurement) for "Active Science" projects. Teachers could guide students in "polygon activities" to collect data that is then analyzed to reinforce basic math or science concepts, making learning more engaging and tangible.

Based on the phenomenon-based learning approach, STEPAM-trained teachers could develop more complex interdisciplinary projects **in Finland**. Students might investigate the physics of a particular sport, using sensors to gather data, programming tools to model movements, and artistic skills to present their findings, thereby deeply integrating PE with multiple STEAM disciplines.

These examples underscore the integration that arises when policy structures, curriculum design, and teacher practices converge on shared goals. Initiatives like STEPAM provide the crucial catalyst for teacher empowerment through specialized training and collaborative networks.

Conclusion

This comparative exploration of Physical Education in Austria, Serbia, and Finland, specifically focusing on its integration with STEAM disciplines, highlights a landscape of shared aspirations for holistic student development alongside distinct national approaches and constraints. All three countries acknowledge the fundamental importance of PE in cultivating motor skills, health awareness, and social competencies. However, the pathways to achieving these aims vary considerably, particularly in leveraging PE for broader academic enrichment through STEAM connections. The analysis reveals that while Austria has a structured, competence-based PE curriculum, its links to STEAM are not systematically formalized. Serbia is on a path of modernization, introducing innovative activity formats, but faces significant challenges related to resources and consistent teacher training for interdisciplinary work. Finland is a notable example with its student-centered, phenomenon-based learning model that inherently supports PE-STEAM integration, yet even here, municipal variations and the pressures of academic subjects can impact consistent implementation.

Beyond the comparative analysis, the central contribution of this paper lies in contextualizing and highlighting the potential of the STEPAM project and its underlying model of embodied learning as a robust response to the identified needs. The challenges in PE-STEAM integration are often rooted in a lack of specific pedagogical frameworks and insufficient teacher preparedness. STEPAM, by focusing on "Teacher Training in Physical Activities and Embodied Learning through STEAM Education," directly addresses these core issues. It offers a pathway from acknowledging the potential of PE-STEAM integration to realizing it in practice by empowering teachers with the necessary skills, knowledge, and resources. Therefore, a key conclusion is that targeted, high-quality teacher education, exemplified by the STEPAM initiative, is paramount for advancing effective and equitable PE-STEAM integration.

Policy directions emerging from this analysis, and strongly supported by the STEPAM philosophy, include mandating adequate weekly time for PE (e.g., at least three hours), defining universal learning goals that encompass motor skills, social-emotional development, and explicit cross-curricular tasks linking PE with STEAM concepts, and strategically integrating technology (such as for self-monitoring physical activity or data collection in "Active Science" type projects). However, such policies will only be effective if accompanied by concerted efforts in teacher education and professional development, drawing on models like STEPAM that emphasize embodied learning, interdisciplinary pedagogy, and collaborative practice.

In conclusion, while Physical Education has historical roots primarily in physical development and recreation, its potential significance for the cognitive, emotional, and social dimensions of child development is increasingly recognized. Austria, Serbia, and Finland provide a rich context for this exploration through their distinct yet shared commitments to cultivating active, well-rounded learners. Their collective experiences, illuminated by the potential of initiatives like the STEPAM project, underscore that targeted improvements at the intersection of policy, pedagogy (particularly through

innovative teacher education in embodied learning), and resource allocation can yield meaningful and lasting positive effects on student health, engagement, and academic success across the educational spectrum.

Funding

This research was conducted within the framework of the STEPAM project, co-funded by the European Union under the ERASMUS+ Programme, Cooperation Partnerships in Higher Education. Grant No. 2023-1-RS01-KA220-HED-000166894 Project title: Teacher Training in Physical Activities and Embodied Learning through STEAM Education (STE(PA)M)

References

Bannan-Ritland, B. (2003). The role of design in research: The integrative learning design framework. *Educational Researcher, 32*(1), 21–24.

Boice, K. L., Jackson, J. R., Alemdar, M., Rao, A. E., Grossman, S., & Usselman, M. (2021). Supporting teachers on their STEAM journey: A collaborative STEAM teacher training program. *Education Sciences, 11*(3), 105. https://doi.org/10.3390/educsci11030105

Bray, M., & Thomas, R. (1995). Levels of comparison in educational studies: Different insights from different literatures and the value of multilevel analyses. *Harvard Educational Review, 65*(3), 472–490.

Bundesministerium für Bildung, Wissenschaft und Forschung (BMBWF). (2012a). *Verordnung der Bundesministerin für Unterricht, Kunst und Kultur über die Lehrpläne der Volksschule, BGBl. II Nr. 303/2012 (idF BGBl. II Nr. 174/2013, 242/2013, 162/2015).*

Bundesministerium für Bildung, Wissenschaft und Forschung (BMBWF). (2012b). *Verordnung der Bundesministerin für Unterricht, Kunst und Kultur über die Lehrpläne für die Neue Mittelschule, BGBl. II Nr. 185/2012 (idF BGBl. II Nr. 345/2019).*

Coe, D. P., Pivarnik, J. M., Womack, C. J., Reeves, M. J., & Malina, R. M. (2006). Effects of physical education and activity levels on academic achievement in children. *Medicine & Science in Sports & Exercise, 38*(8), 1515–1519.

Council of the European Union. (2013). *Council Recommendation of 22 April 2013 on establishing a Youth Guarantee* (2013/C 120/01). *Official Journal of the European Union, C 120*, 1.

Eather, N., Morgan, P. J., & Lubans, D. R. (2013). Improving fitness and physical activity levels of primary school children: Results of the Fit-4-Fun group randomized controlled trial. *Preventive Medicine, 56*(1), 12–19.

Finnish National Board of Education. (2014). *National core curriculum for basic education 2014*. Finnish National Agency for Education.

Grabner, K. (2018). Physical education in the Austrian school system: Historical and contemporary analysis. *European Physical Education Review, 24*(1), 64–80.

Halinen, I. (2018). The new educational curriculum in Finland. *Improving the Quality of Childhood in Europe, 7*, 75–89.

Ilić, S., & Mijatović, S. (2006). *Istorija fizičke kulture* [History of physical culture]. Faculty of Sport and Physical Education.

Kangas, M., Siklander, P., Randolph, J., & Ruokamo, H. (2017). Teachers' engagement and students' satisfaction with a playful learning environment. *Teaching and Teacher Education, 63*, 274–284. https://doi.org/10.1016/j.tate.2016.12.018

Kämppi, K., Asunta, P., & Tammelin, T. (2022). *FINLAND'S REPORT CARD 2022: Physical activity for children and youth.* Active Healthy Kids Finland. https://www.activehealthykidsfinland.fi/

Kiilakoski, T. (2019). *Youth work education in Finland.* Finnish Youth Research Network. https://www.nuorisotutkimusseura.fi/images/youth_work_education_web.pdf

Kirk, D. (2009). *Physical education futures* (1st ed.). Routledge. https://doi.org/10.4324/9780203874622

Kosunen, S., & Kauko, J. (2022). *Finland's famous education system.* Springer. https://doi.org/10.1007/978-3-030-93858-1

Kuusisto, E., Tirri, K., & Rissanen, I. (2012). Finnish teachers' ethical sensitivity. *Education Research International, 2012*, Article ID 351879. https://doi.org/10.1155/2012/351879

Lanas, M., & Kiilakoski, T. (2013). What makes a teacher? A case study of the discursive construction of teachership in Finnish print media. *Scandinavian Journal of Educational Research, 57*(4), 424–437.

Mavilidi, M., Okely, A., Chandler, P., & Paas, F. (2017). Infusing task-relevant physical activities into the classroom: Effects on preschool children's geography learning. *Journal of Science and Medicine in Sport, 20*(Suppl. 1), e109.

McClusky, M. (2009, June). The Nike experiment: How the shoe giant unleashed the power of personal metrics. *Wired, 17*(7), 81–91.

Metsäpelto, R. L., & Pulkkinen, L. (2012). Socioemotional behavior and school achievement in relation to extracurricular activity participation in middle childhood. *Scandinavian Journal of Educational Research, 56*(2), 167–182.

Pokropek, A., Mazzeo Ortolani, G., Karpinski, Z., & Biagi, F. (2024). *STEM competencies, challenges, and measurements: A literature review* (Report No. JRC138618). Publications Office of the European Union. https://doi.org/10.2760/9390011

Quigley, C. F., Herro, D., King, E., & Jeong, S. (2020). STEAM designed and enacted: Understanding the process of design and implementation of STEAM curriculum in an elementary school. *Journal of Science Education and Technology, 29*(4), 499–518. https://doi.org/10.1007/s10956-020-09832-w

Radisavljević-Janić, S., & Milanović, I. (2019). Physical education in the Republic of Serbia. *Physical Culture, 73*(1), 61–70. https://doi.org/10.5937/fizkul1901061R

Riley, N., Morgan, P. J., & Lubans, D. R. (2014). Preliminary findings of the E.A.S.Y. Minds feasibility study: A curriculum based physical [1] activity intervention program in the primary school. *Journal of Science and Medicine in Sport, 17*(Suppl. 1), e99.

Rulebook on the Curriculum and Learning Program for the Fourth Grade of Primary Education. (2019). Official Gazette of the RS – Educational Bulletin, No. 11/19.

Rulebook on the Curriculum and Learning Program for the Second Grade of Primary Education. (2018). Official Gazette of the RS – Educational Bulletin, No. 16/18.

Rulebook on the Curriculum and Learning Program for the Third Grade of Primary Education. (2019). Official Gazette of the RS – Educational Bulletin, No. 5/19.

Rulebook on the Curriculum and Teaching Plan for the First Cycle of Primary Education and Upbringing, and the Teaching Program for the First Grade of Primary Education and Upbringing. (2017). Official Gazette of the RS – Educational Bulletin, No. 10/17.

Sahlberg, P. (2015). *Finnish lessons 2.0: What can the world learn from educational change in Finland?* Teachers College Press.

Sääkslahti, A., Korhonen, E., & Tammelin, T. H. (2022). Physical literacy in Finnish early childhood education and care. *Prospects, 51*(1–3), 319–333.

Thrupp, M., Seppänen, P., Kauko, J., & Kosunen, S. (Eds.). (2023). *Finland's famous education system: Unvarnished insights into Finnish schooling*. Springer. https://doi.org/10.1007/978-981-19-8241-5

Tinker, R. (2000). *A history of probeware* (Concord Consortium Reports). The Concord Consortium.

United Nations Educational, Scientific and Cultural Organization. (2015). *Quality physical education guidelines for policymakers*. UNESCO.

Univerzitet u Kragujevcu. (n.d.). *Tekući i realizovani projekti*. Retrieved May 8, 2025, from https://www.kg.ac.rs/tekuci_realizovani_projekti.php

World Health Organization. (2010). *Global recommendations on physical activity for health*. WHO.