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Balkans: Challenges and Perspectives in Secondary School Physics Education

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Physics education across the Balkan region is confronted with persistent and complex challenges that affect both the quality of teaching and student engagement. Despite being a foundational discipline within the natural sciences, physics attracts a critically low number of students to pursue it further in higher education. In most Balkan countries, fewer than 10% of secondary school graduates go on to study physics or engineering at the university level. Of this small group, only 20–30% are female, reflecting a significant gender gap that continues to resist efforts toward greater inclusion in STEM (science, technology, engineering, and mathematics).

Several factors contribute to this disinterest in physics and broader STEM fields. High school physics curricula are often highly theoretical and disconnected from practical applications, making it difficult for students to see the relevance of the subject. Crucially, many Balkan education systems still lack interdisciplinary programs that integrate STEM disciplines, such as biophysics, bioengineering, or computational biology, missing opportunities to illustrate how science functions in todays interconnected world.

This disconnect has broader implications. The absence of modern, interdisciplinary content contributes to persistently low scores on international assessments like PISA, reflecting gaps not just in knowledge but in critical thinking and problem-solving. While technology initiatives like "One Laptop/Tablet per Child" are often discussed, they remain largely absent in practice—and even when devices are available, they are no substitute for quality educational content. As the saying goes, "the laptop/tablet is not the strength; it is the content that's the strength."Without investment in meaningful, integrated STEM curricula, like initiative Youth@STEM4SF [1] showcases, the region risks falling further behind in cultivating a scientifically literate and innovative next generation.

Outdated teaching methods, limited access to laboratory facilities, and insufficient teacher training compound the problem. Moreover, students often lack exposure to real-world applications and career opportunities in physics-related fields, especially within the regional context. The broader societal undervaluation of science professions, coupled with economic instability, further disincentivizes students from choosing STEM paths.

These challenges have broader implications. The outdated education systems in many Balkan countries limit innovation potential and hinder the development of STEM literacy among youth. Cross-border collaboration and networking opportunities for students interested in STEM are also rare. This is especially relevant in the Balkans, where scientific collaboration can support peacebuilding and regional cooperation. Projects like SEEIIST [2] - modeled after CERN and focused on cancer research—highlight the power of science diplomacy and multidisciplinary STEM synergy. By uniting experts from fields like physics, biology, engineering, and medicine, SEEIIST shows how breaking disciplinary boundaries can drive innovative solutions to urgent health challenges.

This paper outlines the current state of physics education in the Balkans and identifies systemic barriers within secondary STEM education. It argues for a coordinated, cross-national effort to modernize and strengthen science teaching, drawing on insights from both Balkan stakeholders and Swiss STEM education experts. The analysis is structured around several guiding questions that emerged from recent dialogues:

• What proportion of high school graduates pursue university studies in physics and engineering in each country, and what percentage of these students are female?

• What are the root causes of low student interest—are there identifiable gaps in high school science education?

• What methods and interventions have proven effective in raising interest, and how can they be better integrated into classrooms?

• What are the current trends and planned actions to embed sustainable development into science teaching?

• To what extent are physics-based industries involved in high school education, and how can these links be strengthened?

• What governance structures and stakeholders are needed to initiate and sustain reforms in science education across the Balkans?

By addressing these questions, the paper seeks to support policy innovation and foster collaborative regional responses that can shape a more inclusive and future-ready STEM education system in the Balkans - following international pioneering STEM education trends successfully piloted in other countries, such as Switzerland [1,3,4].

[1] B. Bruant Gulejova, Shaping high school science education with tech industry in action for sustainable development, Communications de la Société Suisse de Physique 73, 61 (2024);

https://www.sps.ch/articles/various_articles/
[2] SEEIIST –The South East European International Institute for Sustainable Technologies, https://seeiist.eu/
[3] Youth@STEM4SF (Youth at STEM for Sustainable Future) project, 2024 video: https://www.youtube.com/watch?v=uCvYcsR8qkE;
[4] B. Bruant Gulejova, Role of research and industry to attract future workforce, Europhysics News 56/2, May 2024, https://epn.eps.org/epn-56-2/#14

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