

STEAM approaches, gamification and investigation through the FIND STEM initiative

Carmen-Andreea Burcea, Filipa Baptista, Sarantis K. Chelmis,
Asociația Centru pentru Inovare și Performanță, România, E.C.S.H. – Associação,
Portugalia, 1st Primary School of Rafina, Grecia

Currently, the Romanian education system continues to go through a phase characterized by a lack of formal institutionalization of STEM and STEAM education. The absence of official methodological guidelines, clear procedures or national piloting programs means that this type of education lacks a systemic foundation.

Thus, the most visible progress and practical manifestations are recorded predominantly outside standard school hours, through the efforts of extracurricular clubs dedicated to sciences or robotics. Although there are passionate teachers who have long advocated for such a transdisciplinary approach, their efforts remain fragmented and dispersed, which means that not all students benefit from equitable access to this type of educational innovation.

This deficient implementation is deepened by an often traditional pedagogical approach, where teaching lacks interactivity and new challenges, and theoretical subjects are studied separately, without real interdisciplinary integration. The consequences of this structural void are visible and worrying, reflecting directly in the poor performances obtained by Romanian students in the international PISA tests, especially in mathematics, sciences and technological education.

Looking towards the next decade, the necessity of integrating STEM education becomes evident when analyzing the labor market dynamics. It is estimated that, between 2022 and 2035, the employment rate in Romania will record an annual growth of 0.6% to 0.9%, a significantly faster pace compared to the projected average of 0.3% to 0.4% for the rest of the European Union.

However, this expansion will not be uniform. The sectors that will experience the strongest development are business services, followed by the manufacturing sector. Analyzing in more detail, the field of computer programming and information services will experience a considerable rise. This accelerated digitalization and the transition to an economy strongly oriented towards services bring an acute demand for highly skilled professions.

Forecasts indicate that we will face a significant future shortage of specialists in the field of information and communications technology, as well as professionals in the science and engineering area. To meet these advanced technical and technological requirements imposed by the new labor market, future generations must be thoroughly prepared starting from the school benches. The current educational reality presents a major obstacle in this path. The domestic system faces alarming dropout rates and, especially, a high level of functional and scientific illiteracy.

A fundamental dimension of this educational transition is recognizing the importance of scientific literacy in modern society. Acquiring scientific knowledge and skills is no longer reserved exclusively for future scientists or those aiming for a technical career. It has become a necessity for all citizens, being directly correlated with the capacity for innovation in the workplace and economic prosperity.

To address this complexity of everyday life, the educational paradigm has evolved beyond the limits of the initial interdisciplinary STEM approach. Thus, the model naturally expanded into STEAM by including the arts. The arts do not merely represent an aesthetic element but play an essential role by stimulating creativity and design thinking, which are considered indispensable foundations for innovation.

Recently, the huge volume of information available in various formats has brought to light the acute need for reading skills to understand complex concepts, leading to the emergence of the integrated STREAM model. This new paradigm adds the reading and writing component (Reading), alongside Robotics according to other researchers, realizing that functional literacy and the ability to critically process scientific texts represent the foundation upon which the entire architecture of technological and engineering learning rests.

An eloquent example of innovation efforts in this field is the FIND STEM initiative, "Fostering Innovations and Nurturing Diversity in STEM Education", developed under the aegis of the Erasmus+ program as a small scale partnership between institutions from Romania, Greece and Portugal.

The implementation of scientific education in the classroom often encounters major obstacles, including teachers' feelings of insecurity regarding their own technical knowledge and the absence of professional training programs adapted to modern challenges. An applied analysis has revealed a reality that requires immediate attention, showing that teachers feel the lack of new pedagogical tools focused on real life learning scenarios and practical experimentation, which limits their ability to innovate in the classroom.

To overcome these praxiological barriers, the FIND STEM project intervenes through structural solutions. The direct goal of this training is to increase the confidence level of teachers because, by deeply understanding the principles of integrated teaching and having clear tools available to use in the classroom, they overcome the fear of the unknown.

To materialize this vision, the initiative pursues several strategic objectives: improving teachers' skills in delivering modern and student centered pedagogical content, modernizing classroom practices through the transnational transfer of expertise, and substantially increasing student engagement, especially among girls, through interdisciplinary approaches that combine exact sciences with the arts. Thus, educators become capable and confident in designing attractive lessons

that not only transmit rigorous scientific concepts but also stimulate students' creativity in a friendly learning environment.

To turn theory into practice, the FIND STEM project places a special emphasis on innovative methodologies, integrating inquiry based learning and gamification as central tools to attract students to sciences. Traditional pedagogy is replaced by a challenge based educational design, meant to simulate the activity of researchers and stimulate curiosity. Specifically, the consortium develops a compendium of interactive digital resources, structured in the form of tools called WebQuests and Digital Breakouts.

The former propose investigation scenarios to students anchored in current real life problems, such as sustainable cities, climate change or artificial intelligence, requiring participants to explore, collaborate and find innovative solutions. On the other hand, the Digital Breakout activities bring gamification mechanisms to the forefront, being designed similarly to escape room adventure games. In these virtual spaces, teams must solve a series of scientific riddles and logic games to unlock clues, using technology to advance.

The motivational element is strengthened by awarding digital badges upon completing each mission. This reward, taken directly from the video game world, gives students a sense of achievement and encourages them to deepen technical concepts in relaxed, dynamic and deeply collaborative environments.

In conclusion, for STEM education and its derivatives (STEAM and STREAM) to have a real and lasting impact in Romania, it must not be viewed as a separate entity or a simple supplementary activity, but must be organically and deeply integrated into the existing national curriculum. This transdisciplinary vision, capable of bringing together exact sciences with the artistic and creative side, faithfully corresponds to the requirements of modern society.

However, the main engine of the entire change remains the teacher. Any success in reforming the educational system is strictly conditioned by the transformation of the teacher's role, who is called to abandon the classic pattern of a passive provider of theoretical knowledge. In the new pedagogical structure, the teacher becomes a dedicated facilitator of active learning, guiding students step by step in the exploration process.

Bibliography:

- European Centre for the Development of Vocational Training, *2025 skills forecast: Romania*.
- Ispas, C.-N., *Abordări STEM/STEAM în România: Aspecte praxiologice*, Materialele Conferinței Republicane a Cadrelor Didactice Didactica științelor exacte, Tipografia Universității de Stat din Tiraspol, Chișinău, 2022.

- Șuteu, L.-D. (Coord.), Cristea, R.-M., & Ciascai, L. (Ed.) (2024). *Dezvoltări în educația STEM: STEAM, STREAM și învățarea bazată pe investigație*, Presa Universitară Clujeană, Cluj-Napoca, 2024.
- Vasileiou, K., Tsimpli, D., Giannaki, S., et al., *STEAM în Educația Primară: Ghid de Referință*, Development Center of Thesally, Salonic, 2023.