



Teachers Empowering Teachers: Transforming Science Education through Peer-Led Training

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Abstract

Science on Stage Europe transforms the professional development of primary and secondary science educators through an innovative, peer-driven model that emphasises knowledge exchange and collaboration among teachers. In today's rapidly evolving educational landscape, traditional training methods often fail to equip teachers with the practical skills and innovative approaches required to engage students effectively. Science on Stage Europe fills this gap with a unique "from teachers, for teachers" framework, where training is not only led by educators but also designed with a strong focus on creativity, interdisciplinarity, and hands-on methods that teachers can immediately apply in their classrooms.

At the heart of our approach is the recognition that teachers are best positioned to understand the dynamic needs of their classrooms. Our training programs offer a vibrant platform where educators share practical, classroom-tested ideas in science teaching, explore new technologies, and collaboratively develop strategies to ignite students' passion for STEM. By fostering a supportive network across 35 countries, we provide teachers with continuous access to a wealth of resources, diverse perspectives, and a treasure trove of good examples.

This presentation will highlight Science on Stage's successful initiatives in teacher training, showcasing practical examples that have led to measurable improvements in teachers' motivation, job satisfaction, and student engagement. Attendees will learn about specific methods for designing effective peer-to-peer training sessions, the impact of international exchanges in inspiring educators, and the role of teacher-led innovation in addressing global educational challenges such as AI, inclusion, and sustainability. Science on Stage Europe's approach underscores the importance of empowering teachers as agents of change, allowing them to drive educational transformation from the ground up, and ensuring that students are equipped with the skills needed for a rapidly changing world.

Keywords: *Teacher Training, Professional Development, STEM Education, Innovative Pedagogy, Science on Stage Europe, International Collaboration*

Introduction

In an era marked by rapid technological advancements and evolving educational paradigms, science education faces the dual challenge of staying relevant and inspiring students to become critical thinkers and problem solvers. Traditional teaching methods, often rooted in rote memorization and rigid curricula, struggle to engage today's learners, who are growing up in an interconnected, information-rich world. To bridge this gap, educators must not only adapt to new pedagogical approaches but also empower each other to foster a culture of continuous learning and innovation. In this context, peer-led training has emerged as a powerful strategy for transforming science education, leveraging the collective expertise and experiences of teachers to drive meaningful change. Peer-led training, where educators collaborate, share, not only best practices, but also problems, obstacles and solutions identified, and mentor one another, is grounded in the belief that teachers are the most valuable resources in any educational system. Unlike conventional professional development programs, which often follow a top-down approach, peer-led initiatives empower teachers to take ownership of their learning journey, fostering a sense of community and collaboration, creating a supportive environment, where they feel confident in experimenting with innovative teaching strategies, such as inquiry-based learning, interdisciplinary approaches, and the integration of digital



tools in science education. By doing so, teachers not only enhance their pedagogical skills, but also inspire their peers to reimagine science teaching as an engaging, dynamic, and student-centred experience.

Peer-Led Training

The transformative potential of peer-led training lies in its ability to cultivate a culture of reflective practice. When teachers share their successes and challenges openly, they collectively build a repository of practical knowledge that is directly applicable to the classroom. This collaborative learning process enhances teaching effectiveness while also helping educators navigate the complexities of modern science education. This includes the integration of emerging technologies like artificial intelligence, virtual labs, and data analytics. Furthermore, peer-led training promotes a growth mindset among teachers, encouraging them to continuously seek new ways to inspire curiosity and foster critical thinking skills in their students.

Research shows that teacher-led professional development has a profound impact on teaching quality and student outcomes. According to a report by the OECD (Barrera-Pedemonte, 2016), teachers who engage in collaborative professional learning are more likely to adopt innovative teaching practices and demonstrate higher levels of job satisfaction. This is particularly relevant in science education, where rapidly evolving scientific knowledge and technologies demand educators to stay up to date on the latest developments. By empowering teachers to learn from each other, peer-led training not only enhances content knowledge but actively contributes to building the confidence needed to explore new pedagogical approaches, thereby transforming the way science is taught and learned. The benefits of peer-led training extend beyond individual teacher development by fostering a culture of mentorship and leadership within schools, where experienced educators can guide and support novice teachers. This creates a ripple effect of continuous improvement, as knowledge and expertise are shared across the teaching community. Moreover, peer-led training helps break down hierarchical barriers, promoting an egalitarian culture, where every teacher's voice is valued, and diverse perspectives are embraced. This inclusive approach is particularly powerful in addressing the gender gap and other forms of underrepresentation in science education, as it encourages all educators to contribute to the collective advancement of teaching practices.

Despite its numerous benefits, the implementation of peer-led training in science education is not without challenges, as it requires a paradigm shift in how schools perceive professional development, moving away from one-size-fits-all workshops to a more flexible, teacher-driven model. Additionally, effective peer-led training demands a supportive institutional culture, adequate time for collaboration, and access to resources that facilitate meaningful learning experiences. Addressing these challenges necessitates a commitment from educational leaders to create enabling environments where teachers can collaborate freely, experiment with new ideas, and reflect on their teaching practices without fear of judgment or failure.

As education systems worldwide grapple with the complexities of the 21st century, empowering teachers through peer-led training emerges as a transformative approach to enhancing science education. By fostering collaboration, reflective practice, and a culture of continuous learning, this model equips educators with the skills, knowledge, and confidence to inspire the next generation of scientists, innovators, and critical thinkers. Ultimately, the success of peer-led training hinges on a fundamental belief: teachers empowering teachers is not just a strategy for professional development—it is a movement towards reimagining science education for a better future.

Teacher Training – Part of a Sustainable Strategy

Who We Are and How We Impact Teaching Across Europe?

Science on Stage is a European network dedicated to improving and innovating science, technology, engineering, and mathematics (STEM) education. The non-profit association brings together teachers, educators, and stakeholders from across Europe to share best practices, inspire creativity, and foster collaboration in STEM teaching. The organisation operates under the motto "from teachers for teachers," emphasising peer-to-peer learning and the exchange of innovative teaching ideas, reaching 100,000 educators in more than 30 countries. The Peer-led trainings are part of the Science on Stage strategy:

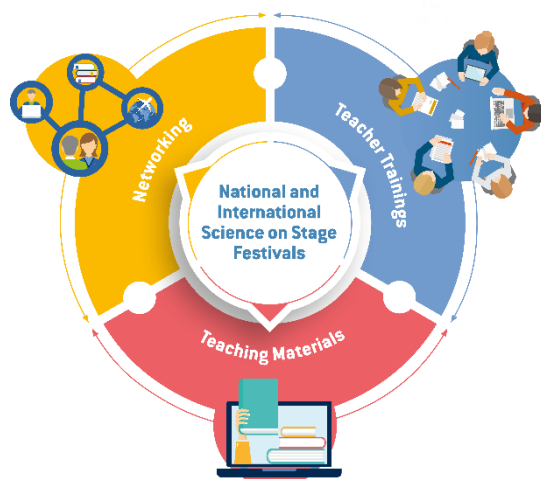


Fig. 1. “How Science on Stage works” (2024)

Its mission is to empower STEM teachers by:

- Providing a platform for sharing innovative teaching methods.
- Encouraging cross-border collaboration among educators.
- Promoting hands-on, inquiry-based learning in STEM subjects.
- Inspiring students to pursue careers in science and technology.

HISTORY – 20 YEARS OF EXPERIENCE

The initiative started in the year 2000, funded for the first seven years by the 7th Framework Programme of the European Commission. With the aim of bringing together the most dedicated teachers in Europe to reduce the skills shortage at EU research institution such as CERN, ESA, EMBL and other, the Science on Stage – formerly known as the Physics on Stage festivals – were the first activities to promote STEM teaching by teachers for teachers and to provide an insight into current research topics.

In different European countries the so-called National Steering Committee were in charge of selecting their innovative teachers to represent their countries at these unique European teacher gatherings. After the funding from the European Commission ended, the representatives of the participating countries founded the non-profit association Science on Stage Europe in 2011, recognised by German law with headquarters in Berlin and funded by GESAMTMETALL. A major milestone achieved, actively contributing to science teaching and teacher support across Europe.

Organised by the different member countries, additional festivals followed at both national and European levels, Słubice, Poland/Frankfurt an der Oder, Germany (2013), followed by London, United Kingdom (2015), Debrecen, Hungary (2017), Cascais, Portugal (2019), Prague, Czech Republic (2022) and Turku, Finland (2024), which celebrated the diversity of STEM education across Europe and featured projects that addressed topics such as robotics, space exploration, and biotechnology. The 14th European Science on Stage Festival will take place from 28-31 May 2026 in Klaipėda, Lithuania.

The Science on Stage Festivals & More

The biennial European Science on Stage festivals are indeed, the cornerstone of the organization's activities. These events bring together hundreds of teachers from across Europe to share their best practices and learn from one another, becoming a hub for innovation in STEM education, inspiring countless educators and students, marking its role as a long-term initiative rather than just a project.



After each festival, the Science on Stage team performs a thorough evaluation of teachers' needs, challenges and ideas. A pre- and post-festival survey is conducted and, based on the results, further steps are initiated.

The results of European Science on Stage festival 2024 in Turku, Finland, highlighted several key challenges faced by teachers in the STEM education field and the support they found through Science on Stage in addressing them. One major issue is the lack of practical teaching materials that align with the curriculum. To address this, Science on Stage offers free, curriculum-oriented materials developed by teachers for teachers, ensuring they are ready to use and designed to promote engaging, modern lessons. All materials are Open Educational Resources. Another challenge is the difficulty of integrating new topics like sustainability or artificial intelligence. Science on Stage provides simple, understandable materials to help teachers introduce these concepts through real-world experiments and applications. The festival also revealed a shortage of ideas for substitute lessons, which Science on Stage can help solve by offering ready-made, exciting teaching units that require minimal preparation. Networking and exchange opportunities among teachers are often limited, as they have pointed out, but Science on Stage helps fill the gap by enabling collaboration through a European network, both digitally and at face-to-face conferences and workshops. Teachers also struggle with inspiration for creative teaching methods, and find encouragement for interactive cross-curricular approaches through Science on Stage, including coding projects and DIY experiments. The lack of accessible, quality training courses was another concern, and Science on Stage contributes to filling the gap with free, hands-on professional development opportunities, both online and on-site. Additionally, many teachers find it difficult to implement the SDGs (Sustainable Development Goals) in the classroom, finding in Science on Stage's concrete teaching projects on Education for Sustainable Development (ESD) a way to simplify this integration. Lastly, teachers often face low motivation, mentioning that Science on Stage's activities help reignite their passion for teaching by connecting them with like-minded colleagues.

These surveys highlighted that Science on Stage supports teachers by offering innovative, practical materials and ongoing training, all aimed at making STEM education more exciting, relevant, and sustainable, fostering greater enthusiasm among both teachers and students.



Fig. 2. Science on Stage in numbers (Factsheet 2024)

Collaboration with the Industry

Science on Stage also collaborates with leading industry partners, research institutions, and policymakers to promote excellence in STEM education, creating a bridge between the classroom and the cutting-edge advancements shaping the future of science and technology. These partnerships have a profound impact on everyday teaching, as they bring real-world insights, resources, and expertise directly into the hands of educators. For example, initiatives like *Coding in STEM Education*, *Quantum Computing in STEM Education* and the new *Career Orientation* project not only enhance



teachers' abilities to integrate coding and computational thinking into their lessons but also provide students with the skills needed to thrive in a technology-driven world. By partnering with major tech companies and academic institutions, Science on Stage brings industry-standard tools, software, and platforms into classrooms, allowing teachers to deliver up-to-date, relevant content that aligns with current technological trends. These collaborations also offer teachers exclusive access to professional development workshops, online resources, and materials that are specifically designed to meet the needs of modern STEM curricula. Additionally, the involvement of industry leaders in creating and testing new teaching materials ensures that these resources are both pedagogically sound and represent the latest scientific advancements. As a result, teachers not only stay ahead of the curve but are also able to inspire their students with practical, hands-on experiences that mirror real-world applications of STEM concepts. In turn, this strengthens students' critical thinking, problem-solving, and collaboration skills, better preparing them for future careers in science, technology, engineering, and mathematics. Through these ongoing collaborations, Science on Stage is able to infuse everyday teaching with the innovation and expertise necessary to keep STEM education engaging, relevant, and impactful.

Conclusion

Over the years, Science on Stage has had a profound impact on STEM education in Europe. The organisation has inspired thousands of teachers to adopt innovative teaching methods, engage their students in hands-on learning, and foster a love of science and technology. By promoting collaboration and knowledge-sharing, Science on Stage has helped to raise the quality of STEM education across the continent. Since its founding, Science on Stage has grown into a vibrant and dynamic network of STEM educators, united by a shared passion for innovation and excellence in teaching. Whether by playing a pivotal role in addressing the evolving challenges faced by STEM educators across Europe, or by fostering collaboration, providing practical teaching resources, and supporting professional development, Science on Stage empowers teachers to reimagine and innovate their teaching practices. The peer-led approach ensures that educators not only share best practices but, at the same time, collaborate on overcoming common obstacles, creating a culture of continuous learning. Through its festivals, workshops, and initiatives, Science on Stage has significantly contributed to improving the quality of STEM education, inspiring both teachers and students alike to embrace science and technology in exciting, meaningful ways.

As it looks to the future, Science on Stage continues to expand its network and resources, committed to empowering teachers, inspiring students, and addressing the challenges of the 21st century through the power of science and technology, remaining at the forefront of transforming STEM education, ensuring that the next generation of students is equipped with the skills, knowledge, and passion to tackle the global challenges of the future.

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