



Learn STEM
Innovative Model of learning STEM
in secondary schools



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School Education ERASMUS+
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Cooperation partnerships in school education

**Overview on existing practices
in teaching STEM through innovative
pedagogical approaches for Germany**

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1 The importance of STEM in Educational contexts

STEM subjects, or MINT in German, have been the focus of education at all levels for several years now. Education leaders are aware that advancing STEM subjects, and with them building the knowledge and skills, are key necessities to ensure the country's long-term prosperity. The STEM subjects are key drivers of research and development, and therefore young professionals are needed in these sectors in the long term.

In Germany, the Federal Ministry of Education and Research has developed an action plan in order to promote STEM in all educational sectors (kindergarten, school, university and further education) (BMBF, 2022). It foresees different offers in STEM subjects like participating in challenges or research activities. The Ministry would also like to strengthen programmes which combine school and out of school activities because they see the chance to improve STEM competences in these kinds of programmes. These programmes should have game-based approaches, so learners will get a playful experience.

In order to develop STEM programmes, the Ministry supports a community platform which brings together all sorts of stakeholders, like professionals, learners, families, companies etc. It appears that out of school places are the right places for young people to get to know STEM without feeling the pressure of school. They get the chance to develop their own ideas into real projects with research and professional preparation.

Still, teaching is of course a main aspect in promoting STEM. Therefore, German schools have been coming up with excellent programmes.

Source: BMBF/Bundesministerium für Bildung und Forschung (2022). MINT-Aktionsplan 2.0. Retrieved from: https://www.bmbf.de/bmbf/de/bildung/digitalisierung-und-mint-bildung/mint-bildung/mint-aktionsplan_node.html



2 Presentation of examples for existing practices in teaching STEM in Germany

In Germany, there has been a drive to promote STEM subjects for many years. Over the years, fascinating projects, networks, programmes and ideas have developed, as the following four best practice examples will show. From so-called STEM schools to student research centres and nationwide networks, there are numerous best practice examples from Germany, only four of which are presented below.

2.1 Presentation of best practice 1:

MINT in Spee

In Paderborn, a secondary school called Friedrich-Spee Gesamtschule Paderborn has got a certificate for being a STEM school. One of their recent practices was a challenge in which learners needed to come up with a possibility to heat water without electricity. Four boys came up with a great idea and won the challenge. They had the chance to work on their idea and try things out in their free time for a whole school year. The school owns its own laboratory for learners.

<https://www.speepb.de/schulprofil/mint/mint-schule/>

These schools play a crucial role in cultivating a robust foundation in STEM disciplines among students. The platform underscores the significance of fostering a comprehensive learning environment that promotes active engagement in STEM activities, enabling students to develop essential skills, knowledge, and a genuine passion for these fields.

The core essence of the platform revolves around the concept of STEM schools and the enriching opportunities they provide to students. STEM schools are dedicated to creating an immersive educational experience that goes beyond traditional classroom learning. The platform accentuates the idea that STEM schools serve as catalysts for inspiring students to explore the realms of science, technology, engineering, and mathematics through hands-on projects, interactive workshops, and collaborative initiatives.

These schools, as Friedrich-Spee Gesamtschule Paderborn, create activities which are thoughtfully designed to ignite curiosity, stimulate critical thinking, and encourage problem-solving skills among students. From conducting scientific experiments to coding and robotics workshops, students are offered a dynamic platform to delve into practical applications of STEM concepts. Such activities not only deepen students' understanding of complex STEM subjects but also cultivate important skills such as teamwork, communication, and creativity. By actively engaging in projects and activities that mirror real-world challenges, students are better prepared to navigate the ever-evolving landscape of STEM professions.

The example of Friedrich-Spee Gesamtschule Paderborn and their challenge also emphasizes the role of educators in STEM schools. It showcases how teachers and



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mentors play a pivotal role in guiding students through their STEM journey, fostering an environment of exploration and innovation. The school also provides professional development opportunities for educators to enhance their STEM teaching methodologies and keep pace with the latest advancements in the field.

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Friedrich-Spee
Gesamtschule Paderborn

Aktuelles Menschen Spee wird 30 Schulinfos Schulprofil Stark in Spee Service Kontakt Suche

Spee

Eine Schule für alle Talente

MINT in Spee

Angebote und Partner in der Sekundarstufe I

- + Gebäude - Ausstattung - Fachräume
- + MINT Fächer im Überblick (Pflichtunterricht)

Schulprofil

Schule im Grünen (BNE)

MINT

- MINT-Schule
- SpeeLab
- Digitalisierung - iPad-Klassen

Source: Screenshot from <https://www.speepb.de/schulprofil/mint/mint-schule/> on 16th August 2023



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2.2 Presentation of best practice 2:

Schülerforschungszentren (Student Research Centers (SRCs))

Schuelerforschungszentren is a comprehensive platform that centers around the concept of Student Research Centers (SRCs) in Germany. SRCs are specialized institutions that are dedicated to fostering a culture of scientific curiosity and inquiry among secondary school students. These centers play a pivotal role in nurturing the spirit of exploration and innovation in young minds, ultimately contributing to the development of a well-rounded STEM (Science, Technology, Engineering, and Mathematics) education landscape in the country.

The essence of Schuelerforschungszentren lies in its commitment to promoting and supporting SRCs across Germany. These centers act as hubs for students eager to delve deeper into the realm of scientific research. They offer a dynamic environment where students can engage in hands-on experiments, collaborative projects, and investigative studies under the guidance of experienced mentors and educators. Through these initiatives, students are empowered to explore their scientific interests, develop critical thinking skills, and cultivate a genuine passion for STEM subjects.

One of the core objectives of the platform is to connect like-minded individuals and institutions that share a common goal of advancing student research and scientific exploration. Schuelerforschungszentren serves as an invaluable resource for educators, administrators, and stakeholders interested in establishing and nurturing SRCs. The platform offers a wealth of information, ranging from best practices and guidelines to success stories and case studies from existing SRCs.

Furthermore, the platform underscores the importance of providing students with access to state-of-the-art laboratories, equipment, and resources that might not be readily available in traditional school settings. By offering a conducive environment for experimentation and inquiry, SRCs contribute significantly to students' academic growth and their eventual career pathways in STEM fields.

In essence, SRCs serve as a hub of inspiration and information for all individuals invested in promoting student-driven scientific research and discovery. It encapsulates the collective efforts of educators, researchers, policymakers, and students who recognize the significance of nurturing a generation of inquisitive minds. Through this platform, the transformative impact of Student Research Centers on the educational landscape of Germany continues to flourish, fostering a new generation of scientifically literate and enthusiastic learners who are poised to make meaningful contributions to the world of STEM.



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2.3 Presentation of best practice 3:

MINT-EC Das nationale Excellence-Schulnetzwerk

MINT-EC, the national excellence network of schools focusing on STEM in Germany, stands out as a shining example of exemplary STEM approaches in the country's education landscape. MINT-EC's multifaceted framework is centered on cultivating a profound understanding and appreciation of STEM disciplines among students, fostering a culture of innovation, and empowering the next generation of STEM leaders.

At its core, MINT-EC serves as a promise of collaboration and excellence in STEM education. The network encompasses a select group of upper secondary schools that demonstrate an exceptional commitment to providing high-quality STEM education. These institutions are recognized as "MINT-EC Schools" and are celebrated for their innovative teaching methodologies, advanced curricula, and dedication to nurturing students' passion for STEM fields.

One of the standout features of MINT-EC is its dedication to fostering interdisciplinary learning. MINT-EC Schools encourage students to explore the interconnectedness of STEM disciplines through cross-disciplinary projects, workshops, and initiatives. By transcending traditional subject boundaries, students develop a holistic perspective that mirrors the real-world application of STEM knowledge, an essential trait in today's complex problem-solving landscape.

The network's emphasis on project-based learning sets an exceptional standard for effective STEM education. MINT-EC Schools integrate hands-on projects and real-world challenges into their curricula. This approach not only deepens students' understanding of theoretical concepts but also equips them with practical skills, critical thinking abilities, and collaborative expertise. Such immersive experiences not only make STEM subjects engaging but also foster a lifelong enthusiasm for learning.

Furthermore, MINT-EC's commitment to professional development stands as a testament to its holistic approach. The network provides educators with tailored opportunities for growth, enabling them to continuously enhance their teaching methodologies, incorporate cutting-edge technologies, and stay abreast of evolving pedagogical trends in STEM education.

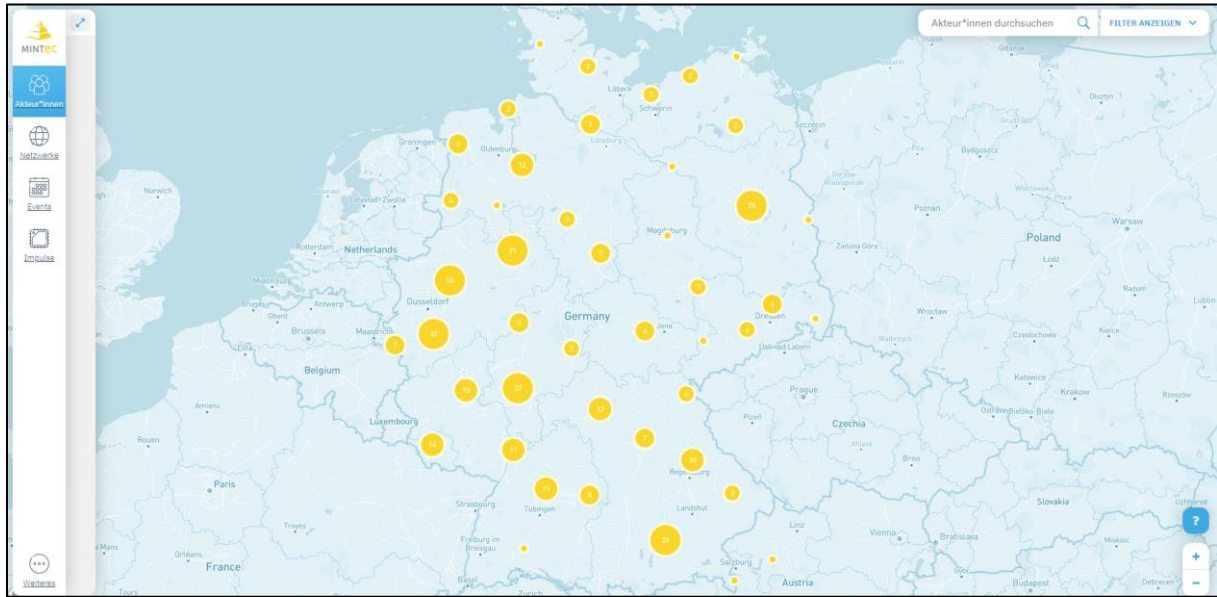
MINT-EC's influence transcends classroom walls. The network actively fosters partnerships with industry, academia, and research institutions, forging connections that offer students a glimpse into the real-world applications of their studies. These partnerships expose students to mentorship, internships, and opportunities to interact with professionals, cementing the link between education and career prospects.



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Source: Screenshot from <https://netzwerkkarte.mint-ec.de/> on 16th August 2023



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2.4 Presentation of best practice 4:

MINT@UniPB

"MINT@UniPB" provides a remarkable demonstration of exemplary STEM practices in Germany, with a particular focus on the University of Paderborn's STEM initiatives. This platform showcases a diverse range of activities and strategies that epitomize effective STEM approaches, emphasizing innovation, hands-on learning, and collaboration to foster a rich educational experience.

At its core, "MINT@UniPB" encapsulates the university's commitment to promoting engagement and excellence in Science, Technology, Engineering, and Mathematics (STEM) disciplines. This initiative vividly portrays the university's dedication to creating a vibrant learning environment that resonates with students' curiosity and enthusiasm. This commitment is highlighted through an excess of activities that exemplify best practices in STEM education.

One of the significant features of "MINT@UniPB" is the multifaceted approach to experiential learning. The initiative showcases various hands-on activities, workshops, and experiments that transcend theoretical boundaries, allowing students to engage directly with scientific concepts. This immersive approach serves as a catalyst for deeper comprehension, nurturing critical thinking skills and a genuine passion for STEM fields.

The University of Paderborn's emphasis on interdisciplinary collaboration stands as a beacon of effective STEM education within the "MINT@UniPB" framework. This initiative encourages students from diverse STEM disciplines to collaborate on projects, reflecting the integrative nature of real-world problem-solving. By fostering collaboration, students develop not only a mastery of their chosen field but also an aptitude for holistic thinking and solution development.

Furthermore, "MINT@UniPB" highlights the significance of research engagement within STEM education. The initiative's commitment to research-oriented learning opportunities, student projects, and partnerships with industry showcases a best-practice model. Such initiatives bridge the gap between academia and practical application, equipping students with the skills and mindset needed to excel in their careers and contribute to scientific advancements.

The emphasis on innovation echoes throughout the "MINT@UniPB" initiative. The platform showcases hackathons, innovation labs, and entrepreneurship programs that challenge students to think creatively and translate their ideas into practical solutions. This approach not only prepares students for the dynamic world of STEM but also nurtures a culture of innovation that fuels progress.



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Source: Logo from <https://www.uni-paderborn.de/universitaet/mintunipb> on 16th August 2023

3 Final comment

The four best practice examples show how diverse and cross-disciplinary STEM approaches can be. Innovative methods have been developed across all levels of education to increase interest and enjoyment in STEM subjects. But special attention is paid to students in schools, as this is where fundamental building blocks for their future careers can be created. And as the examples show, this is certainly possible.