Slovakia – Austria

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Inspiring Education Through Robotics and AI: The ICER Bootcamp Experience

Abstract

This article presents the outcomes of the first phase of the ICE Robotics project bootcamps, conducted between March and June 2025 in Bratislava and Vienna. A total of six three-day bootcamps engaged over 100 secondary school students from Austria and Slovakia in modules on 3D modeling, robotics programming, and artificial intelligence (AI). Quantitative and qualitative feedback indicates significant increases in skill confidence and motivation toward STEM, particularly in robotics. AI modules, while stimulating curiosity, were noted as challenging and in need of scaffolding. Lessons learned highlight the importance of project-based learning, cross-border collaboration, and structured pre-bootcamp preparation. Recommendations for the second phase (Nov 2025–June 2026) include refining AI teaching strategies, expanding robotics challenges, and providing more individualized learning pathways.

The project Inclusive and Creative Education with Robotics and AI is co-funded by the European Regional Development Fund.

Introduction

The ICER project – Inclusive & Creative Education with Robotics and AI – is a cross-border initiative within the INTERREG Slovakia–Austria program. Its goal is to enhance STEM education through robotics, artificial intelligence, and creative technologies in school environments (ICER, 2025). Among its activities, the bootcamps serve as intensive, project-based interventions where students acquire practical skills, strengthen collaboration, and experience international exchange.

This paper summarizes findings from the first six ICER bootcamps, based on official feedback reports (ICER, 2025a; 2025b; 2025c; 2025d; 2025e). It also situates the bootcamp model within existing pedagogical frameworks and literature on robotics and AI in education.

Registration and Participants

Bootcamp participants were recruited through project partner schools in Vienna and Bratislava. Pre-event registration included surveys to determine prior skills, interests, and dietary needs, allowing instructors to tailor sessions (ICER, 2025a). Across six events, more than 100 students and 15 teachers participated, with groups varying in size between 15–25 students.

Project Background

ICE Robotics (www.icerobotics.online) builds on constructivist and project-based learning principles. Seymour Papert (1980) emphasized that meaningful learning arises when learners actively construct knowledge through experimentation with real-world problems. Similarly, Resnick (2017) argues that “people learn best when they are actively engaged in designing and creating things, especially things that are meaningful to themselves or others” (p. 34).

The ICER bootcamps embody these principles by combining hands-on learning, collaborative problem solving, and creative design tasks across robotics, AI, and 3D modeling.

Concept of Bootcamps

Each bootcamp was structured into three modules:
1. 3D Modeling & Printing (Fusion 360, design challenges, prototyping).
2. Robotics Programming (mBot) (sensor integration, navigation tasks, competitions).
3. Artificial Intelligence (introductory concepts, simple demos, ethical discussions).

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In addition to classroom-based activities, students engaged in cultural exchange (city exploration, social events) that reinforced cross-border collaboration (ICER, 2025b; 2025c).

Activities and Outcomes

3D Modeling

Students reported increased confidence in designing with Fusion 360, moving from novice to intermediate skills. One cohort showed an improvement in self-rated confidence from 2.9 to 4.2 on a 5-point scale (ICER, 2025d).

Robotics

Robotics emerged as the most engaging and impactful component. Students consistently highlighted “building and programming robots together” as the most enjoyable activity (ICER, 2025d). Confidence ratings increased significantly (e.g., from 3.1 to 4.6) and participants expressed interest in robotics leagues and competitions (ICER, 2025a).

Artificial Intelligence

AI sessions sparked enthusiasm but were also perceived as the most demanding. Students described content as “too fast and complicated” and requested clearer real-world examples (ICER, 2025b; 2025c). Suggested improvements include scaffolding with step-by-step tutorials and practical applications such as chatbots and game design (ICER, 2025d).

Lessons Learned

Analysis of all six reports highlights several recurring themes:

- Strengths: Hands-on modules, collaborative learning, supportive teaching, cultural exchange.
- Challenges: AI module complexity, accommodation logistics, uneven pacing of sessions.
- Recommendations: Provide pre-bootcamp orientation, extend program length, simplify AI teaching, expand robotics challenges, and ensure logistical improvements (ICER, 2025a; 2025d).

Conclusion and Outlook

The first phase of ICER bootcamps successfully fostered STEM engagement, cross-border cooperation, and student confidence in robotics and digital skills. AI modules require further development to balance accessibility with rigor. The second phase (Nov 2025–June 2026) will incorporate these insights, with a stronger focus on AI literacy, optional advanced tracks, and follow-up opportunities through robotics leagues and online

communities.
As Resnick (2017) and Papert (1980) emphasize, the role of education is not merely to transmit knowledge but to create environments where learners can experiment, collaborate, and innovate. The ICER bootcamps represent one such environment—where robotics and AI become tools for both technical learning and creative exploration.

References

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