Demonstrative Educational Tools Research Group

Our research group focuses on advancing STEM and engineering pedagogy through the development of innovative educational methodologies, interactive tools, and applied mathematical frameworks. A major pillar of our work involves enhancing engineering education via hands-on experimental mechanics, exemplified by the design and implementation of Wheatstone bridge-based didactic devices to cultivate practical problem-solving skills. Complementing these physical tools, we actively explore algorithmic concepts and computer science instruction through context-based approaches to dynamic programming and interactive visualizations, including specialized didactic tools for intuitively demonstrating random processes, mathematical random number generators, and algorithmic structures like magic squares. Furthermore, our interdisciplinary initiatives extend to educational analytics and quantitative modeling, where we develop mathematical models to estimate mother tongue competencies and predict overall learning outcomes, bridging technical discipline design with data-driven pedagogical insights.

Members

- dr. Kakucs András
- dr. Harangus Katalin

Partner institutions

Teacher Training Institute of Sapientia University, Budapest University of Technology and Economics (BME)

Research Grants

1. Problem-Solving Skills in Engineering Education: Challenges and Opportunities for Future Professionals. Supported by the Domus Hungarica Grant of the Hungarian Academy of Sciences (MTA), 1 May 2025 – 28 February 2026.
2. Increasing the Efficiency of Knowledge Transfer in Engineering Teacher Training using Modern Educational Technology Methods. Supported by the Domus Hungarica Grant of the Hungarian Academy of Sciences (MTA), 1 November 2021 - 1 February 2022.
3. A study of the use of context-based algorithm visualization in effective teaching-learning practice. Supported by the Domus Hungarica Grant of the Hungarian Academy of Sciences (MTA), 1 May 2021 – 1 November 2021.

Recent publications

1. Kakucs, András, and Katalin Harangus. "Enhancing Engineering Education Through Experimental Mechanics: A Wheatstone Bridge-Based Teaching Tool." In *International Conference on Interactive Collaborative Learning*, pp. 283-290. Cham: Springer Nature Switzerland, 2025.5 15(2).

2. Kakucs, András, Katalin Harangus, and Zsolt Király. "Magic Square." *MŰSZAKI TUDOMÁNYOS KÖZLEMÉNYEK (EN)* 23 (2025): 28-37.
3. Kakucs, András, Zoltán Kátai, and Katalin Harangus. "A Context-Based Approach to Teaching Dynamic Programming." In *Proceedings of the International Conference on Paradigms of Computing, Communication and Data Sciences: PCCDS 2022*, pp. 671-683. Singapore: Springer Nature Singapore, 2023.
4. Harangus, Katalin, and András Kakucs. "Random Number Generator." *MŰSZAKI TUDOMÁNYOS KÖZLEMÉNYEK (EN)* 18 (2023): 37-44.
5. Harangus, Katalin, András Kakucs, and Gabriella Kovács. "Mathematical Model for Estimating Mother Tongue Competencies and Learning Outcomes." In *International Conference on Interactive Collaborative Learning*, pp. 769-776. Cham: Springer International Publishing, 2022.
6. Kakucs, András, and Katalin Harangus. "Didactic tool for intuitive random process visualization." In *International Conference on Interactive Collaborative Learning*, pp. 649-656. Cham: Springer International Publishing, 2022.