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Supporting students gifted in mathematics through an innovative STEM talent programme

Martin Bracke¹, Patrick Capraro¹, Anna Hoffmann², Sören Häuser³, Christian H. Neßler¹, [Katherine H. L. Neßler](mailto:knessler@mathematik.uni-kl.de)¹ and Andreas Roth¹

¹Department of Mathematics, University of Kaiserslautern, Gottlieb-Daimler-Straße 48, 67663 Kaiserslautern, Germany, knessler@mathematik.uni-kl.de; ²Fraunhofer Institute for Industrial Mathematics (ITWM), Fraunhofer-Platz 1, 67663 Kaiserslautern, Germany; ³ITK Engineering AG, Hahnstraße 70, 60528 Frankfurt am Main, Germany.

Europe is facing an insufficient number of suitably qualified university graduates in the STEM subjects, due to an insufficient number of students choosing to study these subjects and high dropout rates [Eurydice, 2011]. Furthermore, school-age students show a lack of understanding of the value of mathematics, and its potential use for solving real-life problems [Boaler, 2011]. We have been running an innovative talent programme, which gives teams of school students the opportunity to study open-ended and unstructured truly interdisciplinary problems. We present results, which show a remarkable increase in understanding of the students' appreciation of the value of mathematics. We believe such a programme not only teaches students the value of mathematics but will also aid their transition from school to university.

Keywords: STEM education, mathematical modelling, novel approaches to teaching

OUR HYPOTHESIS

Although the number of long-term studies is limited, previous research has indicated that students fail to relate the mathematics they learn in the classroom to the outside world, and feel that the mathematics they learn in school will not be useful for them in their life or career (Boaler, 2011). Research indicates that the understanding of the value of mathematics and enjoyment for the subject can be increased by involving school-age children in mathematical-modelling and problem-solving exercises (Boaler, 2001, Curtis, 2006).

Our hypothesis is that introducing truly interdisciplinary open-ended and unstructured problems, based on real-life STEM problems, at the school-age level increase the understanding of and inclination for the mathematical sciences, as students will see their use in real-life problems. Furthermore, we believe that such a project will support teenagers in their transition to university, by giving them experiences of learning and working independently, rather than learning by rote. As such, we

strongly believe that application of our philosophy within schools could significantly increase the number of qualified STEM graduates within Europe.

THE PROGRAMME

Two years ago we started a programme for teenagers talented in mathematics, which will finish in June 2016. School children from throughout Germany, mainly from schools supported by the MINT-EC network (MINT being German for STEM) were invited to submit an application. From 58 applicants, a rigorous selection process and assessment centre, 24 students, of which 8 are female, were chosen to take part in the programme.

The total programme consists of six separate week-long residential courses, taking place two times a year. The total group of students was split up into four project teams and each team chose a project for the duration of the programme on which they wished to work. The students themselves conceived all of the project goals, initially only being given a vague idea of a subject area in which they could work on. During each residential course, students are free to work on their projects in a relaxed manner as they wish and experts are available, whom the students can ask technical questions, with the aim of this support to be the facilitation of independent student learning. One or two seminars on a mathematical or technological theme are also given at each workshop, for example an introduction to MATLAB, genetic algorithms, Simulink, Raspberry Pi, image processing and metal soldering to name a few.

POSTER CONTENT

The poster will contain further details on the programme, including the four separate projects on which the students are working and pictures of the products they have produced to date. Empirical results from a questionnaire completed by the students will be presented in graphical form, which illustrate the positive effect of the programme in terms of the students' enjoyment of mathematics as well as an understanding of the importance of the subject and its use.

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