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Modelling the storage capacity of 2D pixel mosaics.

Maasz, Jürgen (ed.) et al., Real-world problems for secondary school mathematics students. Case studies. Rotterdam: Sense Publishers (ISBN 978-94-6091-541-3/pbk; 978-94-6091-542-0/hbk; 978-94-6091-543-7/ebook). 99-112 (2011).

From the text: Mathematical modelling is one of the core competencies of today's knowledge-based society. Description and abstraction of real problems by using mathematical language enables the simulation and optimisation of extensive systems with mathematical tools and IT capabilities. Besides, mathematical modelling with students provides new directions in motivation, knowledge transfer as well as problem solving. Therefore, it is recommended that it should be integrated into the interdisciplinary MINT education. For 16 years, the Department of Mathematics at the University of Kaiserslautern has been organising mathematical modelling weeks for selected students of 10th – 12th form. Teachers, too, can participate in this event to broaden their knowledge through further education. In total, 40 students and 16 teachers were engaged for the duration of one week in 8 different and realistic problems from industry, the economy, society, sports, IT and physics. Science assistants from universities and research centres supported each group by offering advice and help, whenever it was needed. During the 2008 modelling week, a team consisting of 5 students and 2 teachers from different schools worked on the optimisation of new two-dimensional (2D) bar codes, the so-called pixel mosaics. The problem was specially developed for students interested in mathematical modelling as well as in IT with experience in any programming language. Due to the complexity of the problem, it is recommended to implement such a task in interdisciplinary mathematics and IT class on AP level rather than in regular class.

Classification: M50 P20
Keywords: mathematical applications; mathematical model building; interdisciplinary approach; coding; information theory; bar codes; two-dimensional bar codes; European article number (EAN); error-correcting codes; quadratic pixel mosaics; StampIt; Aztec code; data matrix; QR code; Quattro code; error correction algorithm; simultaneous linear equations; check sums; knowledge transfer; documentation; student presentations; cryptography; ASCII code