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The Mathematical Reasoning Competency for a practice-oriented Study Course in Mechanical Engineering

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SEFI's Mathematics Working Group has set up a provisional curriculum discussion document ([1]) which is based upon the concept of mathematical competence for engineers as educational goal. Competence here means the ability to cope with the mathematical challenges students encounter in their study course and later on in professional life. The concept was developed in the Danish KOM project ([2]) and was also used in the famous PISA study [5]. In order to make it more operationable, competence is split up into eight competencies which are: Mathematical thinking, mathematical reasoning, mathematical problem solving, mathematical modeling, handling mathematical symbols and formalism, mathematical representation, mathematical communication and usage of aids and tools.

In order to make use of this concept for setting up a concrete curriculum for a study course, one has to specify to which extent these competencies are to be acquired in the study course. In [3], we gave a rough overview how such a specification could be made for a practice-oriented study course in mechanical engineering at a university of applied sciences. In this paper, we investigate the competency of

"mathematical reasoning" in more detail. This competency comprises the ability to follow and understand mathematical statements and arguments made by others and to set up chains of mathematical argumentation oneself. As in the KOM project we use three so-called dimensions to specify to which extent this competency should be acquired: degree of coverage, radius of action and technical level (for an example concerning the mathematical modeling competency see Blomhoj/Jensen [4]). In the first dimension one has to identify those aspects of the competency that should be covered in the study course (section 1). In the dimension "radius of action" the contexts and situations have to be specified in which the competency can be activated (section 2). Finally, the "technical level" dimension provides information on how far advanced the mathematical concepts and procedures are which can be used when applying the competency (section 3). We present several example tasks which illustrate how competency could be acquired and used. ■

REFERENCES

[1] SEFI Mathematics Working Group (2011), A Framework for Mathematics Curricula in Engineering Education, Discussion document December 2011 (http://sefi.htw-aalen.de/Curriculum/Competency%20based%20curriculum _discussion_document_December_2011.pdf, accessed 12/03/23).

[2] Niss, M., Højgaard, T. (2011), Competencies and Mathematical Learning. Ideas and inspiration for the development of mathematics teaching and learning in Denmark. English Edition. IMFUMA, Roskilde University.

[3] Alpers, B. (2011), Using mathematical competencies for specifying a mathe-ma¬tics curriculum for engineers, Proc SEFI Annual Conference 2011, Lisbon.

[4] Blomhøj, M., Højgaard Jensen, T. (2007), What's all the fuss about competencies?, Blum, W. et al. (Eds.), Modelling and Applications in Mathematics Education. The 14th ICMI Study, New York: Springer, 45-56.

[5] OECD (2009). PISA 2009 Assessment Framework – Key competencies in reading, mathematics and science (www.oecd.org/dataoecd/11/40/44455820.pdf, accessed 11/05/17)

[6] Alpers, B. (2010). Studies on the Mathematical Expertise of Mechanical Engineers, Journal of Mathematical Modelling and Application, Vol. 1, No.3, 2-17.

[7] Alpers, B. (2006). Mathematical Qualifications for Using a CAD program. In S. Hibberd, L. Mustoe (Eds.), Proc. IMA Conference on Mathematical Education of Engineers, Loughborough. Engineering Council, London