



HAL
open science

Product orientation in modeling tasks

Wolfgang Bock, Martin Bracke, Patrick Capraro

► **To cite this version:**

Wolfgang Bock, Martin Bracke, Patrick Capraro. Product orientation in modeling tasks. CERME 10, Feb 2017, Dublin, Ireland. hal-01933444

HAL Id: hal-01933444

<https://hal.science/hal-01933444v1>

Submitted on 23 Nov 2018

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Product orientation in modeling tasks

Wolfgang Bock, Martin Bracke and Patrick Capraro

KOMMS, University of Kaiserslautern; {bock, bracke, capraro}@mathematik.uni-kl.de

Keywords: Real-world problems, modelling tasks, client action.

Introduction

Beginning with the first Pisa study in 2000 (OECD, 2001) there is a worldwide discussion of an appropriate education in the so-called STEM subjects. One cause was the alarming fact that in many countries the majority of secondary school students fail to reach proficiency in math and science (Kuenzi, 2008). One significant reaction to the above mentioned debate was to strengthen the role of mathematical modeling in teacher training and the curricula. In Germany, this can be seen from the fact that mathematical modeling is mandatory in most of the recently introduced master programs for mathematics teachers. Moreover, there is a strong increase in the number of publications on mathematical modeling of real-world, realistic or authentic problems over the past decade. The following definition is due to Bock & Bracke (2013):

Definition 1: *An authentic problem is a problem posed by a client, who wants to obtain a solution, which is applicable in the issues of the client. The problem is not filtered or reduced and has the full generality without any manipulations, i.e. it is posed as it is seen. A real-world or realistic problem, is an authentic problem, which involves ingredients, which can be accessed by the students in real life.*

Real-world problems and authentic problems are used and studied in many different modeling activities such as the TheoPrax method (TheoPrax), modeling weeks and modeling days, the Junior-Engineering Academy (Bock & Bracke, 2013), Fraunhofer-MINTeC¹ Talents (Bracke et. al., 2015). Especially in TheoPrax and also the modeling activities in vocational education (e.g. Wake, 2014) the activities aim towards a specified product from the beginning. In product management a product is a deliverable or set of deliverables that contribute to a business solution. In (Kotler et.al. 2006) it is defined as “anything that can be offered to a market that might satisfy a want or need” (p. 230). In the client-provider situation the product thus is the good sold to the client by the provider. It, therefore, is directly related to the needs of the client meaning the task the client gives to the provider. In the real world, e.g. in industry, an actual client is not really interested in mathematical models – very unfortunate to most of mathematicians - but mostly in a tool or a strategy he can directly use for his purposes. In our opinion for modeling activities having real-world or authentic problems this is a dimension which is to be included into the existing modeling process. For authentic and real-world problems we therefore define the notion of a product.

Definition 2: *In a mathematical modeling situation (with an authentic and real-world problem) a product is a deliverable in the language of the client which satisfies the needs incorporated in the*

¹ See also: Fraunhofer MINT-EC Talents programme. <http://www.fraunhofer.de/de/jobs-karriere/nachwuchsfoerderung/mint-ec-talents.html> and MINT-EC e.V. <http://www.mint-ec.de>

task given by the client to the provider in such a way, that the client can use it directly for his purposes.

Research questions

At the University of Kaiserslautern modeling activities including products have been performed for years. Even in the first modeling week in 1993 one can find in 3 of 8 projects concrete products such as computer programs and strategies. It is planned to study how modeling tasks and the development of products changed during this time based on the reports of past modeling activities. It is to expect that both changed with the introduction of computers and the increase of programming skills. For this purpose we intend to analyze existing material from the past 23 years on how strong the focus on project orientation in the modeling tasks have been. The use of computers during the modeling weeks is well documented, however the data is not enough for empirical studies. Thus for a more involved study we plan to gather material from other universities involved in modeling weeks. Furthermore we want to investigate how the client action during the modeling process changes the whole process of the modeling cycle and the product itself. A product can in reality be produced without a modeling cycle; on the other hand the modeling cycle can be performed without producing a product. However the quality of the product can be improved by an iterated mathematical modeling process in most cases. The client in this case plays the role of an external control in the sense that he/she will accept or not the product. He/she can also ask for new features or ask for specific extensions. To study this we plan to apply different approaches (with client/without client) to different but similar groups in modeling activities. The performance of the group should be investigated via video analysis, such that we can estimate how often a modeling cycle was performed.

REFERENCES

- Bock, W., & Bracke, M. (2013). Project teaching and mathematical modeling in STEM subjects: A design based research study. In Ubuz, B. and Mariotti, M.A. (Eds.), *Proceedings of the Eighth Congress of the European Society for Research in Mathematics Education* (pp. 1010–1020). Antalya, Turkey: ERME.
- Bracke, M., Capraro, P., Kreckler, J. & Roth, A. (2015). The Fraunhofer MINT-EC Math Talents Programme. In Vondrova, N. and Krainer K. (Eds.), *Proceedings of the Ninth Congress of the European Society for Research in Mathematics Education* (pp. 959–960). Prague, Czech Republic: ERME.
- Armstrong, G., Kotler, P., Harker, M. and Brennan, R. (2009). *Marketing: An introduction*. Harlow, England: Pearson Education.
- Kuenzi, J. J. (2008). *Science, Technology, Engineering, and Mathematics (STEM) Education: Background, federal policy, and legislative action*. CRS Report for Congress. Retrieved from <http://www.fas.org/sgp/crs/misc/RL33434.pdf>.
- OECD (2001). *Knowledge and skills for life: First results from PISA 2000*. Paris: OECD.
- TheoPrax Center (Pfinztal, Germany). (2014). *NWT-Unterricht in Pfinztal*. Retrieved from <http://www.theo-prax.de/de/projekte/an-schulen/nwt-unterricht-pfinztal.html>.

Wake G. (2014). Making sense of and with mathematics: The interface between academic mathematics and mathematics in practice. *Educational Studies in Mathematics*, 86(2), 271–290.