DFG Research Center MATHEON

Teaching computer-oriented mathematics (CoMa) in an enjoyable way

C. Gräfe[1], F. Franke[1], Prof. Dr. C. Schütte[2], Prof. Dr. R. Kornhuber[2], Annika Siebert[3], Harald Bröckelmann[3],J. Kaltenbaek[4]

1) University FU-Berlin, Bioinformatic, (christine.graefe@gmx.de) 2) DFG Matheon, (www.matheon.de) 3) Creos Lernideen und Beratung GmbH (www.creos.de) 4) Center for Media Research (CMR) FU-Berlin (www.cmr.fu-berlin.de)

Abstract:
Teaching computer-oriented mathematics (CoMa) is a complex task. There is always a risk students get lost in formulae and don't understand the conceptual meaning. This applies in particular to important but unpopular topics like round-off errors, condition numbers and stability. Therefore, a first CoMa-eLearning software was developed by the research center Matheon that avoids difficult mathematical speech but keeps mathematical correctness and completeness. The structure of the software is didactically geared to Gagne's nine-events-of-instruction. The flash based serious game guides the students to topics by involving them in a dialog with a philosopher and an engineer. Explaining condition by playing interactive golf or talking about history events like the disaster of Ariane 5, students learn the conceptual meaning of CoMa and the usefulness of knowing about in an interactive and enjoyable way.

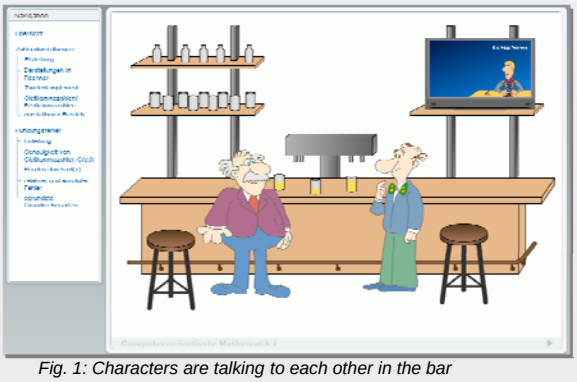


Fig. 1: Characters are talking to each other in the bar

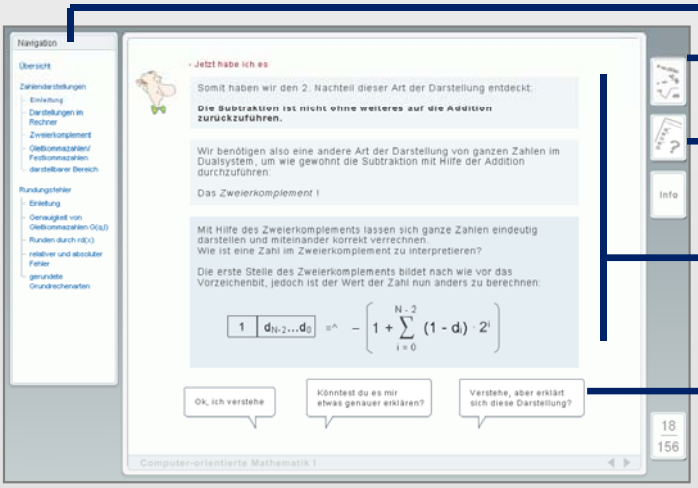
Introduction:
The CoMa-eLearning Software can be used to accompanying lectures and books or to learn completely independent of it. To prevent the often mentioned eLearning feeling "to learn alone" easy and relaxed dialogues take place in a bar. The learner is introduced to the topic by a playful dialogue between an engineer (who regards everything from the computer world perspective) and a philosopher (who explains all with a mathematic-philosophical aspect).

The CoMa-Software is didactical orientated at the "**Nine Events of Instruction**" by Robert Gagné:

1. Gain attention - To motivate the student, each chapter starts with a story of something happened in real live, e.g. the disaster of Ariane 5. Questions arise that motivate the students to go into detail and to learn more about the causes and the usefulness of computer-oriented mathematics. The stories are either told by the CoMa-News at the bar on TV, or questions are asked during a PitPat play that the user plays interactively with the engineer and the philosopher.

2. Inform learners of objective
After the introduction one of the characters asks the user, if he wants to go into detail. Then he informs the user about the following content of the chapter.

3. Stimulate recall of prior learning
The content of each chapter is based on the previous one. During the dialog, the characters remind the user of the previous talks and link the new content to previous knowledge. The main facts are stored in a formulary, that can be accessed any time.



- Formulary, contains the main facts and is accessible for the user any time
- Multiple choice tests at the end of each chapter. The user decides when to take the test himself.
- Dialog with one of the characters or both.
- Navigation provides cross linked learning
- Multiple answers for the user guide to different degrees of difficulty

Fig.2: User interface in a chapter

4. Present the content and
5. Provide "learning guidance"
The user is directly involved in a dialog with the philosopher and the engineer. To appeal to different learning modalities, a variety of media is used: Text, graphics, animations and interactive tasks alternate during the dialog. To avoid passive learning, the user always has to be interactive by answering questions proposed by the engineer and the philosopher. Different choices of answers provide different levels of difficulty. The characters avoid difficult mathematical speech but keep mathematical correctness and completeness.

6. Elicit performance (practice) - 7. Provide feedback - 8. Assess performance
To confirm the correct understanding and to increase the likelihood of retention the user is asked to perform tasks. Specific and immediate feedback is always given by the characters. If the user has difficulties to perform a task, they try to help in a friendly way. Each chapter closes with multiple-choice-questions (MC). The questions focus on the conceptual meaning of the content.
A wrong answer guides the user back to that position in the program where it is explained.

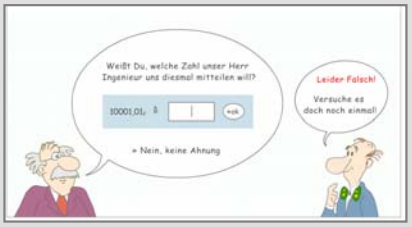


Fig. 3: A given task for the user

9. Transfer: Chapter 1 to 4 will be transferred to linear systems of equations, applying the previous topics.

Structure of the program:

	Chapter 1	Chapter 2	Chapter 3	Chapter 4
Motivation:	Disaster of Ariane 5	Patriot Missile in the Gulf War	Playing inactive PitPat, learning the amplification of input data error	„highest common factor" - contest
Content:	number systems, representation, floating Point numbers	rounding-errors	numerical condition stability	Analysis of different algorithms, efficiency of algorithm

Transfer:
Combing Chapter 1 to 4 by analyzing linear system of equations, using Gauss algorithm

Evaluation:
At last, the complete software will be usability-tested and evaluated by the attendants of the lecture. Suggestions will be used to further develop and improve the CoMa-Software. First results show a good acceptance.