New Media in Mathematics Training

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Abstract

The goal of the project ”New Media in Mathematics Training“ is to integrate elements of electronically supported learning into the mathematical training at universities and ”Fachhochschulen“. New forms of teaching will be applied to a number of selected courses in ”pure“ mathematics as well as in areas needing mathematics as ancillary science. By concentrating on well-established ”regular” courses and taking into account the different conditions and resources at the partner institutions, a sustainable effect on the mathematical training system is envisaged.

Preliminaries

At present, the possibilities provided by modern information and communication technologies are used rather scarcely in mathematics training and universities and ”Fachhochschulen“. This applies for areas in which mathematics plays a supporting role, as well as for the education of future mathematicians and mathematics teachers. In the former case this seems to be due to the fact that mathematical techniques are utilized for a broad range of purposes, which in turn limits the amount of available electronic learning material. Furthermore, only very few time is spent on mathematics training in most of these areas. In the latter case of ”pure” mathematics, the existence of a well-established set of analytical methods and paradigms provides a certain barrier against the use of novel forms of visualization and interaction. In addition, the institutions experience different basic conditions, and the wide-spread spectrum of expertises of the lecturers implies a variety of approaches and teaching methods.

On the other hand, students are confronted with severe problems, in particular during their first semesters. Their knowledge brought from school is diverse and often inadequate. A

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major problem in mathematics courses for beginners is to establish a necessary common standard. Deficiencies and shortcomings in their earlier mathematics education – or simply the complexity of the mathematical content – implies lack of understanding and frustration.

The project ”New Media in Mathematics Training“ strives to cope with this situation. Aiming at interaction and communication, the technologies of the World Wide Web provide a variety of means to support the process of understanding und the motivation. Beginning with a selected number of courses held at different institutions, an attempt is made to integrate elements of electronically supported teaching and learning into mathematics training. The composition of the project team represents a broad spectrum of requirements, basic conditions, experiences and resources.

Project Dates and Consortium

The project was submitted within the framework of ”New Media in Universities and Fachhochschulen, 2nd call“ („Neue Medien in der Lehre an Universitäten und Fachhochschulen, 2. Ausschreibungsrunde“, see http://www.nml.at/) and is just about to start, running over the next two years. It will be funded by the Austrian Federal Ministry for Education, Science and Culture.

The project consortium consists of the following institutions:

- ”mathe online” team, Faculty for Natural Sciences and Mathematics, University of Vienna
- Institute for Philosophy, University of Vienna
- Institute for Psychology, University of Vienna
- Institute for Sociology, University of Vienna
- Department of Engineering Mathematics, Geometry and Computer Science, University of Innsbruck
- Institute for Mathematics, University of Vienna
- Carinthia Tech Institute
- WIFI Wien und Fachhochschulstudiengänge der Wiener Wirtschaft (FHW)
- Paedagogical Academy in Vienna
- Institute for Institute for Communication Science, University of Vienna

Activities

Development and Adaption of Web Based Material

In close cooperation, suitable web based materials are developed and adapted. Thereby two goals have to be met:

- A high degree of coherence of the material, despite the broad spectrum of areas involved. This applies in particular to mathematical background texts, visualizations of mathematical key notions and exercises of general character. Material of this type

should also be appropriate the use in other areas – not represented in the project – in which mathematics plays the role of an ancillary science.

- Consideration of the specific characteristics of the different courses, areas and existing curricula. This mainly applies to specializations not relevant for all areas, but also to activities affected by technical and organisational issues (e.g. the use of particular software in technical areas).

The web platform used will be designed as an extension of the existing mathematics portal ”mathe online“ (http://www.mathe-online.at, whose smaller English version ”maths online“ is accessible from http://www.univie.ac.at/future.media/moe/). Together with material already developed for the use in school math education, this will give rise to a pool of mathematical learning units smoothly passing over from school issues to university content, thus providing a helpful tool for students.

Application in Regular Courses

In close cooperation, all partners will develop scenarios for the selected courses. In order to achieve a sustainable effect on the mathematical training system, the focus is on ”regular”, well-established courses being part of existing curricula in the different areas. The new concepts have to be integrated into these structures. Most courses are ”traditional” university lectures, supplemented by an exercises course.

The role of information technology is two-fold:

- Application of interactive learning units (which, depending on the scenario, are processed by the students in a computer-equipped lecture hall or at home).

- Additional asynchronous tools for (asynchronous) communication among students and between students and lecturers. This allows – at least to some extent – a continuous distance support.

The main motivations for this action are:

- Modern web technologies provide new possibilities to understand complex mathematical issues. This is in particular relevant for the transition from school to university/”Fachhochschule”.

- The problem of extremely large student numbers in some areas.

Taking into account the different resources at the partner institutions, these actions will be applied during the next four semesters.

Video Sequences

In addition to the web based material described above, several short video clips dealing with mathematical key notions and methods will be developed and produced. Their purpose is to take into account cognitive types of learners, who learn and understand easier and faster by listening and watching rather than reading. The chosen topics will be applicable for a broad group of students and areas. The clips are generally accessible to the students and may thus be viewed on demand. Whenever appropriate, they may be used during the courses as well.

Live Events

As a more experimental track, live events (synchronous communication), supporting the community aspect of learning, will be organised. Two scenarios are envisaged:

- MOO/chat: The lecturer provides web based material accessed by students using their web browser. The synchronization is realized by the functionality of an educational MOO (= Multi-user domain Object Oriented). Simultaneously, a chat provides the possibility for discussion. This scenario is considered to be suitable for a repetition or summary of a lecture.

- MOO/audio: The voice of the lecturer is transmitted to the students. Again the simultaneous presentation of web based material is synchronization by a MOO. In some cases an additional chat (or one-way-chat for asking questions) may be reasonable. This scenario is considered to be suitable for ”question time”-like-events or (panel) discussions about general topics.

The events are recorded and made accessible to the students for later use on demand. Both scenarios will be tested with respect to acceptance by the students and suitability of the technology for the communication about mathematical content. The realization and evaluation of this project track will in particular need the cooperation of dedicated students.

MathML

In order to cope with the technological evolution, it shall be tested whether the XML based Mathematical Markup Language (MathML) and respective tools are suitable for being used in everyday course issues.

Final Conference

At the end of the project (presumably in autumn 2004), a final conference will be organised.

Afterwards ...

… the material and tools developed will generally be accessible. A thorough project documentation shall help future initiatives to profit from the experiences gained.