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Conception of Interactive Software Modules in the Engineering Sciences

by

Karola Koch

Project E-Learning with the ILIAS-Platform at the Universität der Bundeswehr Hamburg

Different Schools Show Different Types of Teaching

- Engineering sciences are characterized by a combination of lecture („know-that") and exercise session („know-how")

- the lecture provides a general theoretical framework

- the lab session puts the theoretical basis into practice and provides concrete examples

  (cf. Banse, „Überlegungen zu einer Wissenschaftstheorie der Ingenieurwissenschaften")

Interactive Software Modules as an Added Value in Teaching Engineering Sciences

Working Hypotheses

- Interactive software modules can fill the gap between lecture and exercise session

- produce synergistic effects for both lecture and exercise session

- facilitate the knowledge transfer

- and thus make teaching more effective.

Interactive Modules as a facilitation of the knowledge transfer

- E-learning modules are appropriate scenarios for the illustration of complex and/or abstract relationships central in particular disciplines to make them vivid and concrete

- interactive multimedia elements form the nucleus of a possible scenario

- the manipulable element is embedded in a structured context, e.g. algorithms, analyses or processes

Interactive Modules as a facilitation of the knowledge transfer

Two Objectives Were Aspired for Further Software Development

- The interactive and manipulable element should be abstract enough to fulfill the needs of variable disciplines

- the example could be central in a certain discipline and hence be concrete

Meeting with the Collaborators in the Engineering Sciences

The training courses given by the collaborators originated from

- Mathematics for engineers
- Control engineering and Material Handling
- Signal Processing and Communications I + II
- Data Processing in Construction
- Thermodynamics
- Fundamentals of Chemistry
- Standardization and Technical Drawing
- Vehicle Technology and Motive Power Engineering

Meeting with the Collaborators in the Engineering Sciences

**The following methods are traditionally applied in exercise sessions**

- Confronting students with exercises/setting problems and working them out
- questions, answers and tests
- construction and graphical illustration of solutions
- displaying processes with simulation-tools
- software-training

Meeting with the Collaborators in the Engineering Sciences

Requests for an assistance in an e-learning environment were the following

- Formula editor
- provision of the new data-type VRML to display 3D-models
- integration of VRML-data and Java-classes to animate 3D-models
- drag & drop (n, m) - matrix

Realization of the drag & drop (n, m)-Matrix
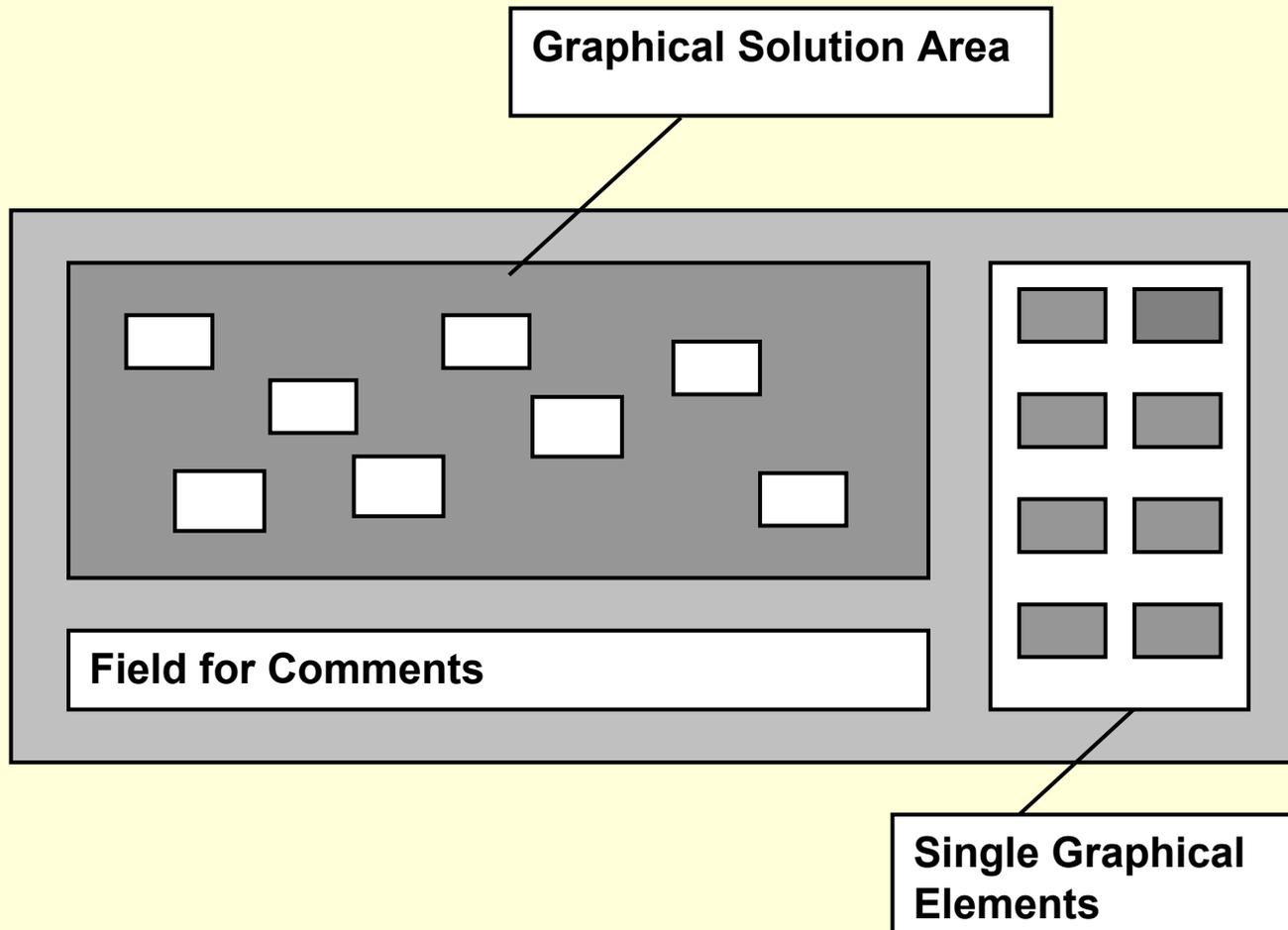
Change Needs
Change Management

An important result of the discussion process with the collaborators was the identification of four stages, each of them with specific requirements which have to be fulfilled in order to create an adequate and successful e-learning module.

The Conception of an E-Learning Module Takes Four Steps

The first step

- Reflection and extraction of subject matters

- identification and specification of central points

- construction of a hierarchy

- description of the context

The Conception of an E-Learning Module Takes Four Steps

The second step

is the provision of a methodological framework and has to reflect

- facts and rationales
- sequences or processes
- analyses or syntheses
- complex relationships etc.

in order to support the learning process.

The Conception of an E-Learning Module Takes Four Steps

The third step

The provision of an adequate multimedia layout needs

- technical know-how
- knowledge of design elements
- creative realization and illustration of the methodological elements

The Conception of an E-Learning Module Takes Four Steps

The fourth step

is the culmination point of the last three steps and has to reflect for instance

- characteristics of the target group
- the specifications of subject matters and the objectives
- the methodological framework
- the function of the chosen media and auxiliary tools and materials
- the general organization of the learning space (cf. Kerres et al.)

to bring about synergies between the last three steps and to complete the embedding in a teaching context.

Conclusions

It became evident that

- there was a real demand for our proposal for an improvement of knowledge transfer but

- basic needs in the engineering sciences, e.g. the formula editor, had to be satisfied first and last but not least

- a complex conception like an interactive software module must be motivated on the four stages outlined before, i.e. the expected output is dependant on an adequate input on each level in a sequential process of construction

Perspectives

- The realization of the drag & drop (n, m)-matrix could be the starting-point for a growing collection of interactive and manipulable elements abstract and general enough be utilized in different contexts and to form the basis not only for a wide range of applications but also for the proposed interactive software modules.

- And we already have concrete examples and would be glad to realize them in the near future.