

Interactive teaching and learning platform in Energy Technology

Marianne Salomón, Torsten Fransson and Vitali Fedulov
Department of Energy Technology
Kungliga Tekniska Högskolan
[Royal Institute of Technology]
SE-100 44 Stockholm
Sweden

marianne@energy.kth.se

Introduction

Since the early-90s, there has been an important revolution in information technology. The Internet has become a worldwide network whose growth is now unquestionable. It is more than just a fashion accessory as it reveals a need for these new communication means. In this respect, multimedia, which can be defined as an interactive combination of media, mainly text, picture, graph, sound and video, appears nowadays as a major tool in information distribution.

The 20th century has been rich in terms of innovation processes in information technology. However, there is one place that has not been strongly affected by information technology: the classroom. Peculiarly, teaching methods have hardly changed over the last hundred years.

In this context, the Division of Heat and Power Technology at the Royal Institute of Technology started to develop Computerized Education Platform (CompEduHPT), an interactive learning platform which sets a new standard for e-learning of energy technology in a global life-long learning perspective (Figure 1). The main objective of the platform is to enhance the learning by providing to the students and teachers the necessary multimedia tools. This has been done through the use of a platform in which the information has been collected, processed and presented in a pedagogical way using several multimedia advantages.

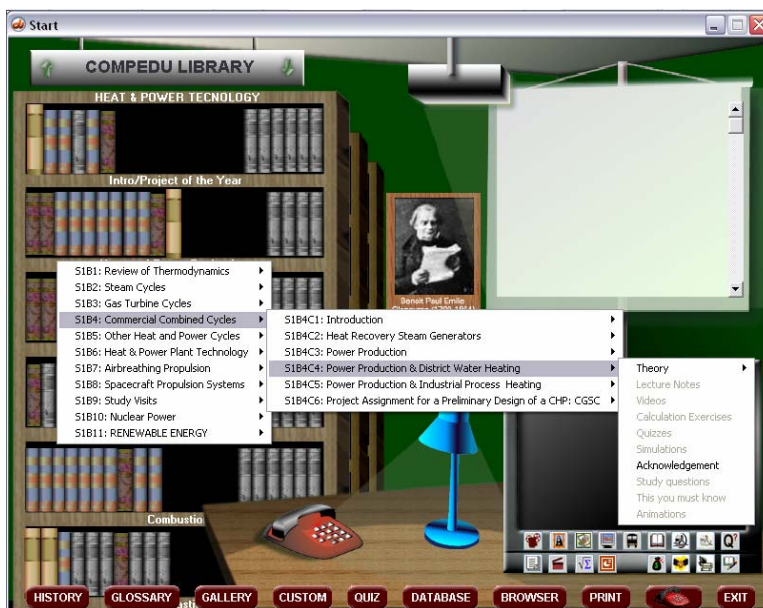


Figure 1. CompEduHPT main interface

The computerised learning platform contains theoretical sections in the form of several e-pages for each available chapter, with a significant number of related interactive simulations, movies, animations, virtual laboratory exercises, study visits and realistic case studies. Significant background information related to historical development in the field, a display of existing components, nomenclature, multi-lingual dictionary and keywords, as well as questions for self-assessment and examinations, an electronic communication group and a local database of the user's 'successes and failures', enhance the learning process in a significant way.

The program is intended as a platform for an international collaboration on learning energy technology. It can be used both in the classroom as well as for self-studies and is as such well adapted for both university and post-university learning, both on and off campus. Tools to facilitate the introduction of new material exist.

It is thus hoped that teachers at different universities can join forces and in a non-competitive way by introducing material which can be shared, instead of developing similar simulations with somewhat different interfaces.

Design of the e-learning platform

The introduction of the blackboard during the 19th century represented a breakthrough in the traditional method of teaching. Today, the introduction of computerised presentation techniques and overheads has also changed the teaching process. This has made possible to show to the students more material related with the specific subject. In special videos, simulations and other multimedia tools represent one of the most relevant changes in the traditional learning. Moreover, the process of teaching and learning in a distant course scheme has been significantly modified. In that sense, the opportunities and advantages presented by computerised learning are enormous with the possibility enhance the interactivity and thus, the learning.

However, the advantages of multimedia educational tools as a complement to traditional education are not obvious for everyone. In 1994, the Association for Applied Interactive Multimedia (AAIM 2004) published a report that highlighted the following advantages of multimedia education the:

- assimilation rate is 65% higher than with traditional method;
- training consistency is 50 – 60% better;
- assimilation speed is 38 – 70% higher; and
- memorization of information is 25 to 50% higher.

Therefore, multimedia becomes a key element in education for the following reasons:

- It increases the learning speed: A multimedia educational program is available all the time. It can bring support to the teacher in terms of availability. Teachers have their working hours during which they have to share their time among the classroom's students, whereas the computer is always available depending on its user's willingness.
- The more the students use it, the less it costs.
- The quality is the same for every student and does not depend on the teacher's skills anymore.
- It integrates the basics of any subject, which are very often responsible for the non-success of the students.
- It improves the student's assimilation because it stimulates all senses of the human body. Multimedia enriches pedagogy by mixing different media. Good multimedia educational software simultaneously stimulates different senses, resulting in better assimilation and memory. Each student reacts differently in these two processes; for instance, some appreciate visual memory, others oral memory. Multimedia is a combination of graphics, sounds, music, voice, videos and animation. These different media are consistent throughout the training software with the objective of stimulating the user's senses.

Considering the reasons mentioned above, great emphasis has been made on the use of multimedia features in the Computerized Educational Platform, *CompEduHPT*. The

platform has been designed as a stand-alone multimedia tool based on the traditional concept of books in which chapters are the main core of the teaching/learning process. The books are grouped in shelves according with their main subject (see Figure 1). There are presently 6 shelves or main subjects within Heat and Power Technology as Fransson, Hillion and Klein (2000) have described previously:

- **Introduction and project of the year:** contains an introduction to the e-learning platform and general overview of energy issues including environmental taxes as well as the purpose, specifications and examples of the Project-Based Learning that is taught in the Division.
- **Heat and power cycles:** contains information about heat and power cycles, propulsion cycles and virtual study visits.
- **Turbomachinery:** presents the different components of steam and gas turbines, fundamental equations, two-dimensional velocity triangles, design parameters, cascade flow, numerical methods and transonic flow in turbomachines.
- **Measuring techniques:** contains few measuring techniques associated with turbomachines. It includes pressure, temperature, flow velocity and mass flow measurements as well as flow visualization techniques.
- **Combustion:** presents some combustion basics as well as combustion chemistry, laminar and turbulent flames, solids combustion and pollutants emission, combustion devices, catalytic combustion and thermal radiation from combustion processes.
- **Aeroelasticity:** includes topics such as introduction to aeroelasticity, basics of aeroelastic systems, structural models, classical flow models and experimental techniques.

Fransson et al. (2000) have explained that each book contains several chapters. Each chapter has a theory part in form of e-pages, videos, simulations, calculation exercises, lecture notes, quizzes, case studies, study visits and lab exercises (see Figure 2).

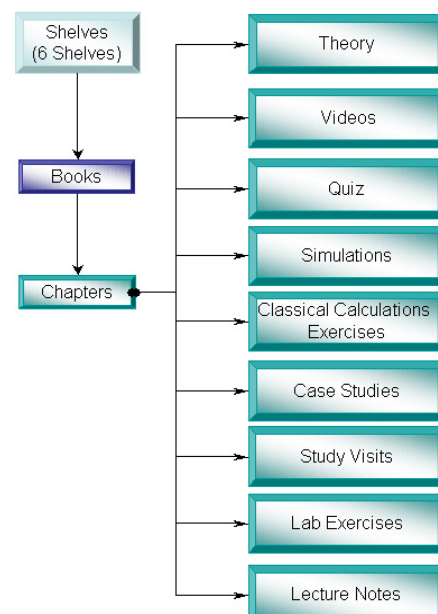


Figure 2. *CompEduHPT* Outline

As can be seen from Figure 2 the content of the program has been organised in such a way that the user is able to navigate freely in the package and understand the relationships between the different parts. Moreover, the contents are organised in a progressive degree of difficulty to help newcomers to understand the basics behind the phenomena and achieve a progressive learning while giving the opportunity to review more complex theories to those students already familiar with the basics.

As Figure 2 suggests the purpose of the platform is more extensive than other computer tools developed for learning. It is not limited to have a collection of overhead slides (Figure 3) in which the theory is presented but also to fully exploit multimedia features to facilitate and improve the learning process and particularly to support the learning in the project-based learning course. Therefore, additional components such as animations, videos, virtual study visits, quizzes and simulations have been included. Although several multimedia features have been considered it has not been forgotten traditional learning tools such as calculation exercises, lecture notes and case studies, which are presented in *CompEduHPT* in an interactive way to the student. Moreover, virtual and remote lab exercises have been included to help the student for the real lab exercises facilitating the theory in form of e-pages and also through simulations of the laboratory exercise.

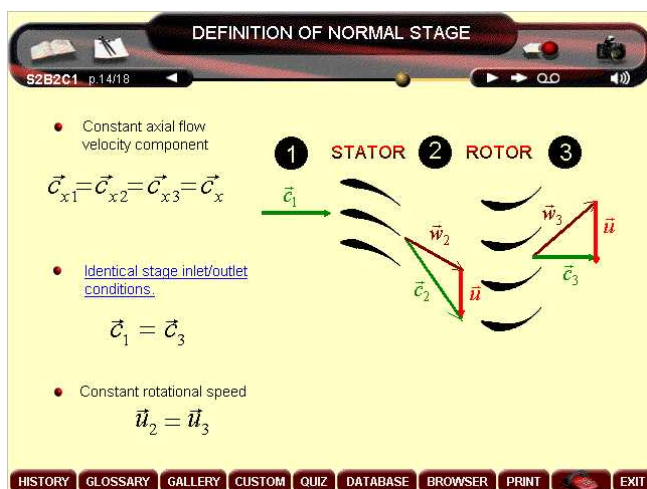


Figure 3. Theory Page

Additionally, other program utilities are available in a toolbar at the bottom of the screen. This toolbar contains a glossary, history about turbomachines and scientists related with the field, gallery of different turbomachines, browser, help, and a local database with the user's successes and failures plus the possibility to perform a quiz or printout the theory part. A discussion forum is available not only for students at Kungliga Tekniska Högskolan but also for students using *CompEduHPT* at other universities. Furthermore, the possibility to participate in e-lectures through the use of audiovisual conferences from experts in the different subjects is available for distant or local learners to complement their theoretical review of the material provided by *CompEduHPT*. These e-lectures are totally interactive if the distant learners have the necessary features such as a fast connection and a web camera/microphone.

All these features together constitute a complete e-learning environment to facilitate the assimilation of the different concept by the students.

Summary

An electronic learning and teaching platform for the field of energy engineering is presented. It is believed to be the first complete electronic textbook in the field which covers the main essential ingredients in a modern educational environment such as:

- presentation of the basic theory in an electronic, interactive form together with printed versions of the material in the classical form;
- 'pop-up' for further very detailed information;
- interactive simulations with guided messages;
- movies and animations;
- virtual and remote laboratory exercises;
- virtual study visits;
- case studies;
- polyvalent glossary;
- electronic discussion groups; and
- interactive exercises and examination questions.

This type of new electronic learning platform can hopefully serve as a base for a better teaching and learning environment in a global life-long education in the field of transforming chemically bound energy to heat and power in the future.

References

- AAIM (2004) Association for Applied Interactive Multimedia, [Online] Available: <http://www.aaim.org/>.
- Fransson, T.H., Hillion F-X. and Klein, E. (2000) *An international, electronic and interactive teaching and life-long learning platform for gas turbine technology in the 21st century*. ASME TURBOEXPO 2000, May 8-11, 2000, Munich, Germany. Paper 2000-GT-0581.