SIMULATION AND HYPERMEDIA - THE KEY TO EDUCATION

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Abstract

The PrintSim, an open and flexible simulation and multimedia system for learning printing processes, special situations, sequences and modern automation systems was developed in a joint project with several European partners under the European Union's COMETT II (Community Programme for Education and Training in Technology) Programme. The PrintSim consists of several software modules and provides a notable more cost-efficient way to give training and education than by using full-scale production printing lines. PrintSim simulation modules are *the Web Offset Newspaper and Heatset Simulator, the Flexographic Simulator, the Offset and Flexographic Expert System* and *the Course Generator*. The PrintSim hypermedia modules are *Filmless Plate Making, Offset Inks, Offset Print Quality, HIFI-Printing, Digital Screening, Flexographic Printing Practice* and *Flexographic Printing Theory*. A new research and development project - *PostPressSIM - Computer-aided training system for book binding, finishing and mailing has been launched* utilising multimedia and three dimensional virtual reality factory simulation. The time schedule of this project is 1995-1998.

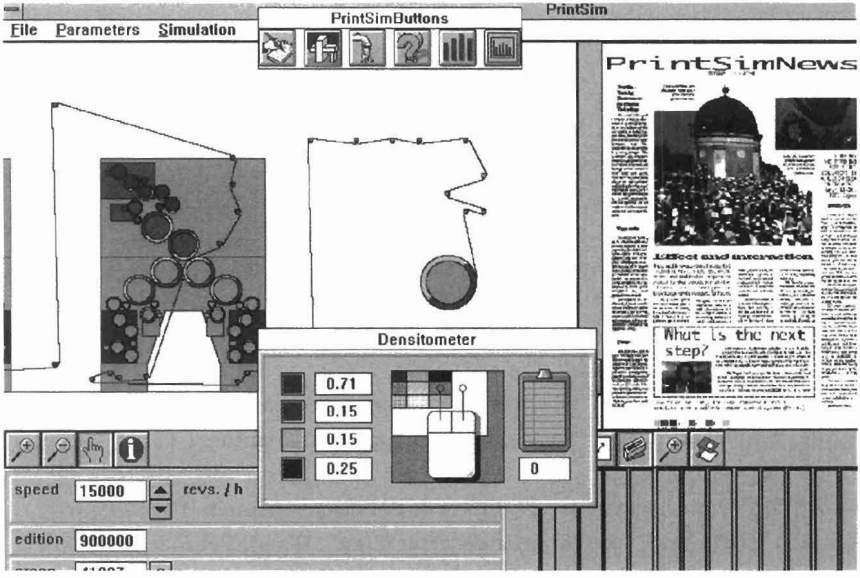

Figure 1. A part of the user interface of the PrintSim simulator.

Background

The continuous trend is toward more colour in printed products, while the standards set for print quality are higher than ever before, web widths and production speeds have increased, and the competition for productivity is growing stronger. The capabilities and limitations of the available presses need to be known at all levels of the organisation in order to make right and quick decisions for maximum production and optimum quality. It is therefore most important to have a better understanding and control of the printing process in different situations and of the modern automation systems and remote controls of the press.

Learning and training special situations with a real printing machine is very expensive (material and labour costs as well as the operating expenses of the press) and often quite impossible because of the risk of causing damage to the press in extreme conditions. Besides, the purchase of a printing machine for training purposes is too large an investment for most companies and schools.

Simulation is today a standard method for the training of professional people in occupations in which human errors would be costly and dangerous. Computer simulations provide an almost true-to-life environment for the trainee, yet without the risks. Simulation programs have been used for quite some time in the training of airline captains, astronauts, navigators and divers. With new program instruments and artificial intelligence it is now possible to construct expert systems for complicated processes with many variables. This also includes the printing process.

VTT Information Technology of the Technical Research Centre of Finland has employed simulations in research and development since the early 1970s. Based on the Rech models, the first simulation models were developed to study colours and the water feed. From there, the next step was a commercial simulation program, PRESSIM, to evaluate new press constructions and automation.

The simulation system provides an essentially more cost-effective way to give training and education than by using full-scale production printing lines. Also the purchasing costs of the simulation system are much lower than the costs of the corresponding printing press line, and the system can simultaneously serve as a simulator for several kinds of printing press lines.

The idea of a training simulator for printers came up while VTT was working with Honeywell Oy Finland (known as Altim Control at the time). The first complete PrintSim simulator with a built-in remote control system (Printa) was produced in 1987, and an expert system was used to provide the dynamics of the offset process.

The next goal was to replace the sophisticated and expensive remote control system by a personal computer based system. The result was a new PrintSim

software family which is a flexible and dynamic simulation and multimedia system for learning the printing process its special situations and sequences at all educational levels.

The new system enables to train present and future users of printing technology (including managers in charge of press purchases, plant production managers, foremen and printers) and instructors at printing trade schools and in the industry. The system and the teaching materials are suited for both schools and printing houses. During the project from July 1992 to June 1995 also courses and seminars were held to train instructors and to test the simulation and multimedia material.

The research results of the partners in different parts of Europe, their knowledge of processes and know-how on teaching and course materials have been integrated into a complete, modern system for the teaching of printing technology. In the development project of the EU-COMETT II programme; the contractor was EGIN, European Graphics/Media Industry Network, Sweden; and the co-ordinator was VTT Information Technology, Finland. Other system development partners were UNINOVA, Instituto de Desenvolvimento de Novas Tecnologias, Portugal; GOC, Grafisch Opleidingscentrum, the Netherlands; EVITECH, Espoo-Vantaa Institute of Technology, Finland; UIAH, University of Art and Design Helsinki, Finland and Botkyrka Kommun Grafiskt Centrum, Sweden.

The learning process and the pedagogical aspects

Computer-aided instruction systems are often designed with a view to technical considerations and overlooking the cognitive aspects. They mostly support lower-level information processing and the external control and regulation of the users' activity. Educational multimedia support experiential rather than reflective cognition and an attractive appearance supersedes the depth of thought and the systems encourage imitation, which means conversion of new technology to old practices.

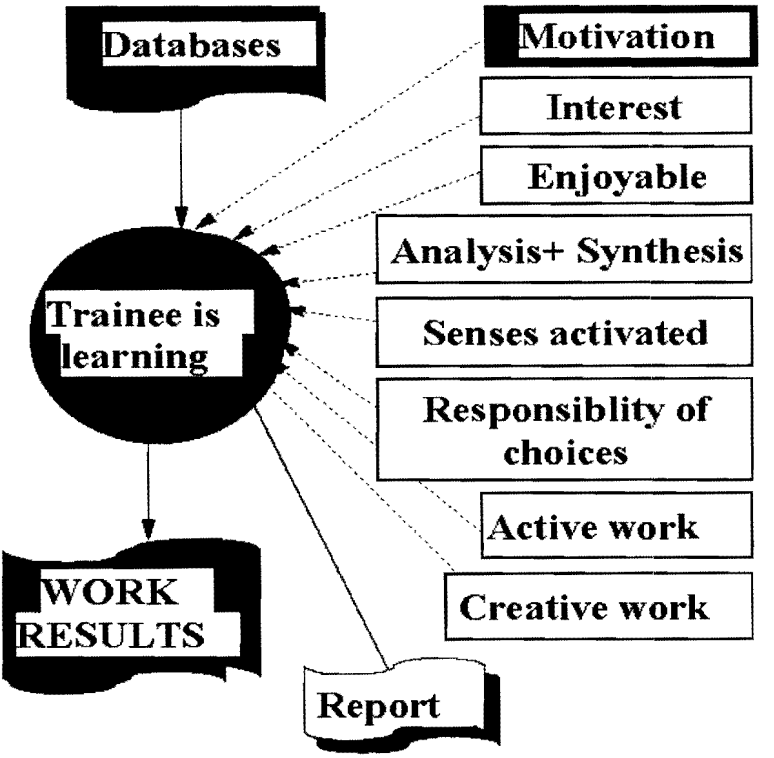

Figure 2. Pedagogical aspects of computer aided education

The cognitive principles of an educational technology support reflective thinking and higher-level knowledge processing, including metacognition and self-regulation. Computer systems should not replace the users' thinking but provide support at the critical stages of the problem-solving processes. The training system should activate the user and support the cognitive processes by writing and visualization.

The PrintSim Course Generator (CG) supports active work by the trainee in different ways. With the text editors of the CG, the teacher can write instructions for the trainee and following these on-line instructions the trainee is able to use the PrintSim system interactively without the teacher's supervision.

Using the CG the student can also write notes and comments and answer questions written by other students or by the teacher. The course database of the CG is open for modifications by the user and the different test forms are editable. The first type of the test forms is a check list and another type is an option list with radio buttons - all the texts in these forms are open for changes by pressing the edit button in the form (Figure 3.). The trainee has to answer the questions and select the right answers to the optional choices or sequences. The teacher can also save a special starting point for the simulator and the press configuration

with the course as the initial state of the simulator. For example there is a certain misregistration and the acceptable quality tolerances are selected for the densities and register errors when the trainee starts the course lesson .

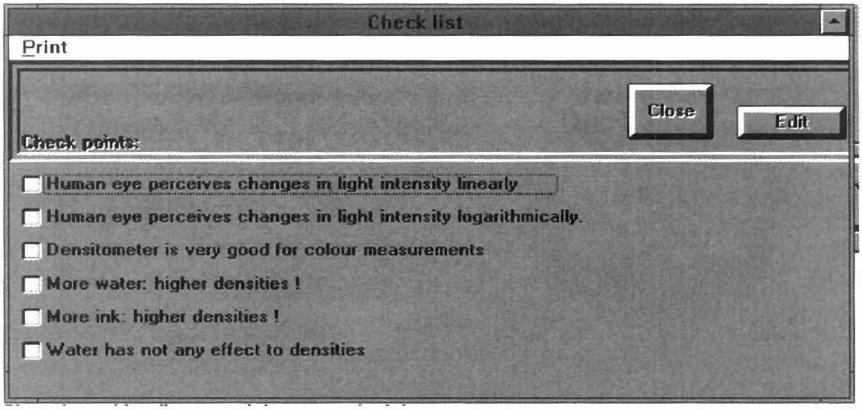

Figure 3. An editable check list form of the PrintSim Course Generator. The teacher can modify all the texts by clicking the edit button.

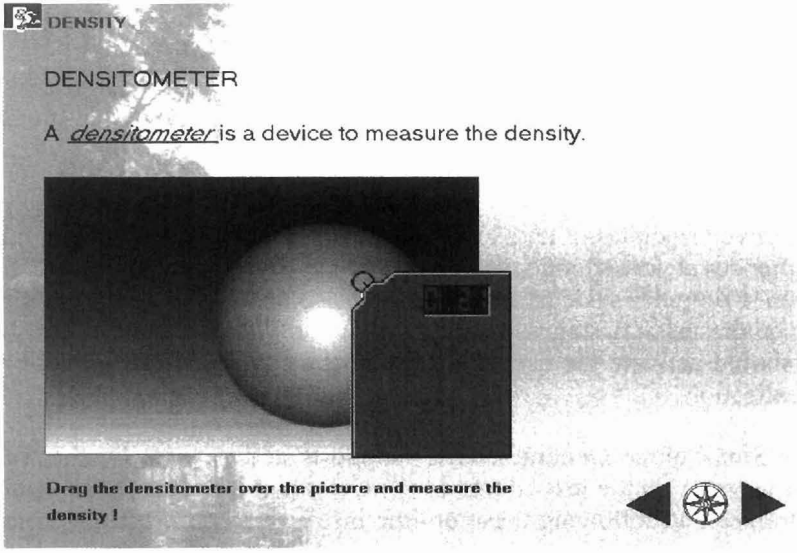

Figure 4. A sample page of a multimedia module about "What is a densitometer".

A very effective way is learning by teaching or by writing an essay on a selected topic. This kind of creative work is also possible with the Course Generator, which is also an easy-to-use authoring tool for the hypermedia.

With the CG the user can create links to images and links to the pages of the multimedia modules. For example if the topic of the student's essay is "Ink Density and the Densitometer", he/she could easily create a link to the right pages of the multimedia module "Print Quality", as shown in the attached figure (Figure 4.).

Simulator modules

The PrintSim offset simulator works with various selectable newspaper and heatset press configurations and the Flexographic simulator works with a CI-type central impression reel-to-reel flexographic machine six ink colours (Figure 5). The press is seen with different zoom factors and many controls are adjustable. The presetting of the ink feed can be selected automatically from the plate scanner or manually according to the plate images on the screen. The ink and water ductor roller, the water blade controls and the separate ink keys are controlled in a very realistic way. The simulated plate scanner is able to show the plate images and the proof on the screen. The colour and folder register controls have also simulated measurements for register errors.

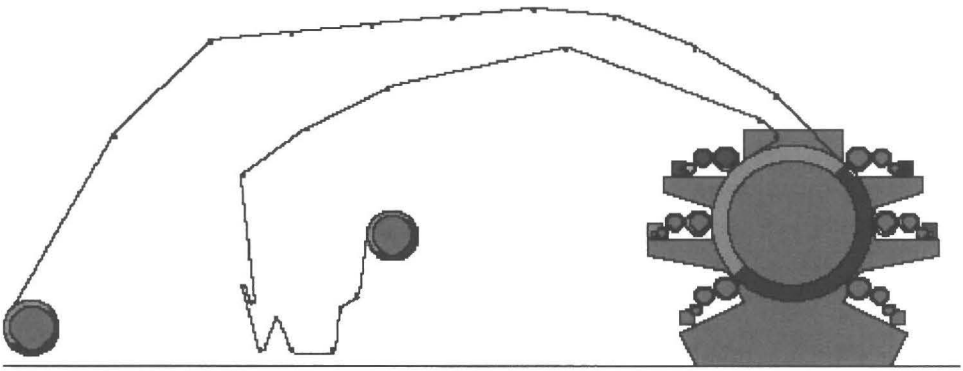

Figure 5. The simulated 6-colour flexographic press

The operations with the training simulator before printing are realistic because, for example the page images for the simulator can be designed by any desk-top-publishing system of the user.

Figure 6. The loup display on a sample page.

Also HIFI separations are possible with up to six ink colours on the same page and the page images can be seen in different zoom factors on the screen. A densitometer, a magnifying glass for register error inspection and a loup for dot inspection are special quality control tools for the trainee (Figure 6). The four filter densities can be copied from simulated densitometer to any spreadsheet software for further analysis (Figure 1). Additional display windows show the figures or graphic charts of the gross, net and waste quantities in copies; the density profiles of dot percentages (100, 75, 50 and 25%) ; the ink layer thickness profile in micrometres, the water layer thickness profile, the water emulsification level and the trend and history displays.

All the above mentioned process parameters can be saved for analysis. Also the state of the simulator can be saved and reloaded.

Multimedia modules

The multimedia modules can be used independently of the PrintSim system but links are easy to create from the Course Generator. The multimedia modules are like electronic hypertext books with texts, images, animations, videos and other effects. The authoring capabilities of the Course Generator increase the interactive and creative utilization of the multimedia, because the user can create own courses with the links to the selected pages of his/her several multimedia modules.

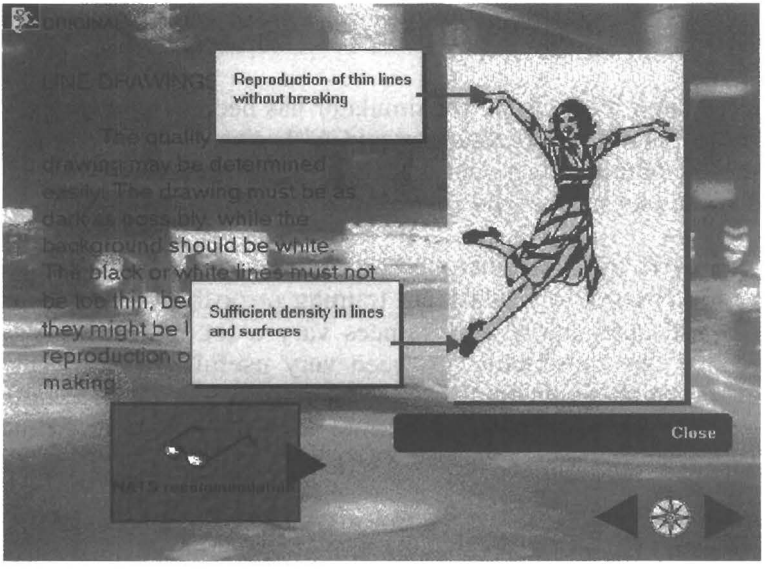

Figure 7. A sample of the PrintSim multimedia module Offset Print Quality with open hypertext areas.

The PrintSim hypermedia modules are Filmless Plate Making, Offset Inks, Offset Print Quality (Figure 7), HIFI Printing (Figure 8), Digital Screening, Flexographic Printing Practice and Flexographic Printing Theory. Each module contains about 100-200 pages of high-quality multimedia material.

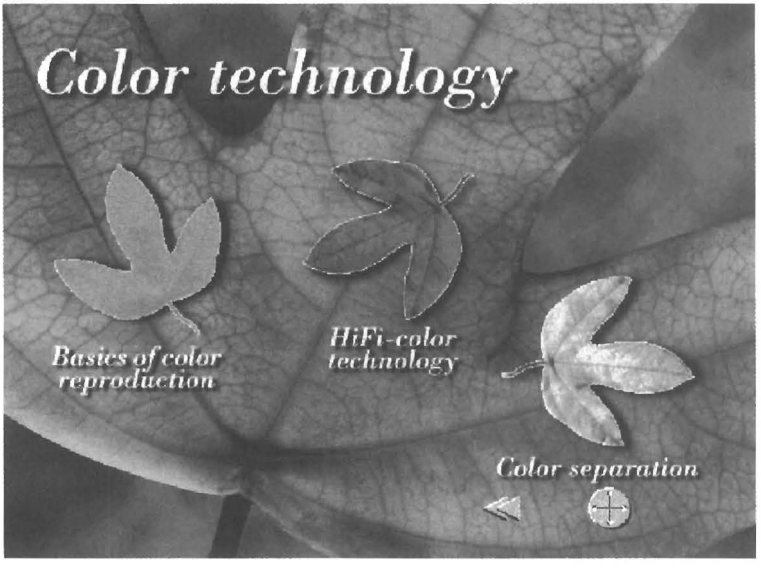

Figure 8. An example of the PrintSim multimedia module menu with the navigation buttons.

Practical training results

The earlier version of the PrintSim simulator has been in educational use at the Espoo-Vantaa Institute of Technology and AEL since 1989. The new PrintSim system with the multimedia modules has been installed and education has begun in several vocational schools and other educational institutes in many countries.

Some of the users train students who are future foremen and engineers while others arrange courses for continuing training or postgraduate education. The basic skills and curricula of the trainees vary a lot. The PrintSim with the simulation and the multimedia has been very useful and the feedback very favourable. For example one teacher on the trainers' course said that after this the computers are a must in printing training as well - other departments, e.g. prepress have used computers for a long time.

These courses have indicated that multimedia and simulation are very suitable for self-learning and therefore also suited for private and business users in the printing industry.

Future development

New features will be developed with remote education to support the PrintSim and there is a new European joint project called *PostPressSIM - The computer-aided training system for book binding, finishing and mailing.* PostPressSIM is a part of the *LEONARDO DA VINCI - programme to establish vocational training policy within the EU.*

The PostPressSIM will introduce innovative multimedia and low-cost three dimensional factory simulation into the training of complicated after-printing processes. The system will be suited for schools and companies, and with different basic skills.

The knowledge and know-how of the different partners will be integrated into a new educational system. The partners will contribute their special skills with a view to the educational and pedagogical aspects at university level; with an understanding of the need for continuing vocational and life long learning; an expertise in the graphic design of multimedia and user interfaces; and with their research results in graphic arts and commercial virtual-reality simulation applications.

A three-dimensional virtual-reality simulation system for different products and production lines, and supporting multimedia modules, will be developed and tested in the project. The educational multimedia modules will be 1. Newspaper mailing systems, 2. Magazine and folder finishing machines, 3. Book binding, 4. Packaging fundamentals and 5. Packaging materials. Also a free demonstration

system will be developed for the multimedia and virtual reality simulation (Figure 7).

The partners of the new project are in Sweden, Portugal, Germany, Norway, Denmark and Finland.

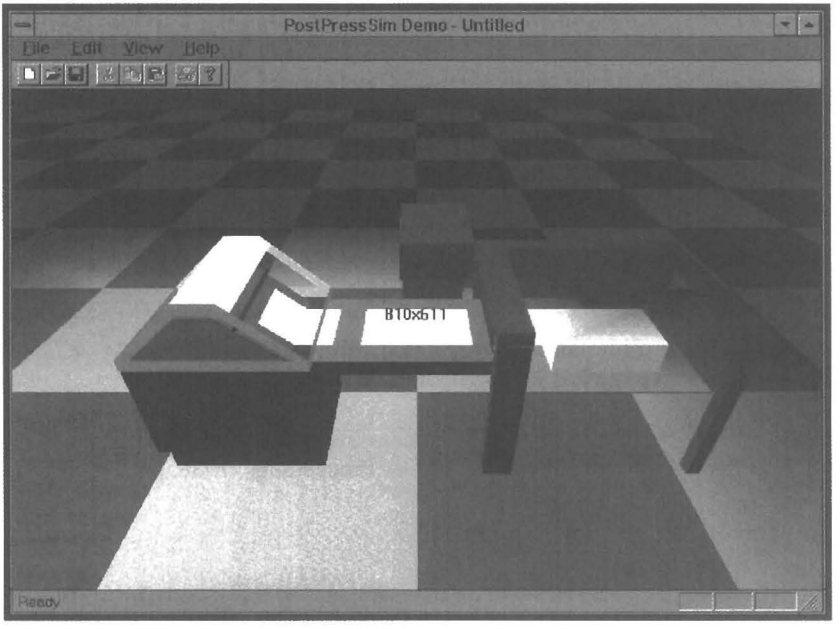

Figure 7. A sample design of the PostPressSIM demonstration system.

The virtual reality simulation and multimedia will make the PostPressSIM system very realistic and easy to use by different groups who need not to be closely connected with the real machines. With the flexible changes in the configuration of the simulated factory, the system can be adjusted to different demands.

Conclusions

New educational technologies are important to the graphic arts industry for many reasons. Vocational schools have difficulty in getting new students and companies have problems with recruiting new employees to their printing and finishing departments. The reasons for this are the low status of the work, the night jobs in newspaper presses and the lack of skilled craftsmen. Because of the increasing demands for performance and economy in the industry and to raise the status of the job, new and effective learning methods are needed in printing. Multi-skilled craftsmen will be needed in the printing industry in the future, too, because of the wide variety of products and production machine types. In the future digital printing (on demand, etc.) will be one solution but there, too, are

complicated finishing stages and new machine types and combinations are needed for distributed printing.

The PrintSim and PostPressSIM systems are demonstrated on the web sites in the Internet and free demo software is also available. The PrintSim web site location is *http://www.vtt.fi/tte/printsim/* and the PostPressSIM is available at *http://www.vtt.fi/tte/samba/projects/postpres.sim/index.htm.*

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