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Modeling And Simulation As The Basis For Hybridity In The Graphic Discipline Learning/Teaching Area

Authors

Viliko Žiljak*[1], Klaudio Pap[1], Jana Žiljak Vujić[2], Josipa Lajkovič[2]

[1]*Faculty of Graphic Arts*
University of Zagreb, Croatia
**E-mail: vilko.ziljak@grf.hr*

[2]*Polytechnic of Zagreb, Croatia*

Summary

Only some fifteen years have passed since the scientific graphics discipline was established. In the transition period from the College of Graphics to «Integrated Graphic Technology Studies» to the contemporary Faculty of Graphics Arts with the University in Zagreb, three main periods of development can be noted: digital printing, computer prepress and automatic procedures in postpress packaging production. Computer technology has enabled a change in the methodology of teaching graphics technology and studying it on the level of secondary and higher education. The task has been set to create tools for simulating printing processes in order to master the program through a hybrid system consisting of methods that are separate in relation to one another: learning with the help of digital models and checking in the actual real system. We are setting a hybrid project for teaching because the overall acquired knowledge is the result of completely different methods. The first method is on the free programs level functioning without consequences. Everything remains as a record in the knowledge database that can be analyzed, statistically processed and repeated with new parameter values of the system being researched. The second method uses the actual real system where the results are in proving the value of new knowledge and this is something that encourages and stimulates new cycles of hybrid behavior in mastering programs. This is the area where individual learning incurs. The hybrid method allows the possibility of studying actual situations on a computer model, proving it on an actual real model and entering the area of learning envisaging future development.

Keywords

hybrid learning, modeling and simulation, graphics technology

Introduction

Application of graphic technology simulation models, experimental work with them and comparison of simulation experimenting results with results acquired in the actual system would encourage researching of diverse approaches to learning and teaching. Sophisticated program simulators are introduced into graphic education. The methodology of teaching graphics technology in the contemporary form begins with the progress made in computer science and the Internet and organizing expert knowledge databases from a wide graphic area. New teaching plans have been developed for the development of methodology in learning graphics technology, subject-matters have been modernized and scientific and expert meetings have been conducted that point out to the necessity to introduce changes into the schooling system. The development of new knowledge teaching/learning methodology as well as the development of new thesis on parameter interdependency in complex graphic systems presented in this paper is tested on basis of actual usage in some Croatian companies such as the printing house «Zrinski».

Changes in the manner and contents when learning graphic technologies are seen on basis of text-books in our regions: Franjo Mesaroš wrote an extensive work that has rightfully earned the title of «Graphic Encyclopedia» (1971) due to its internal and external parameters. His books and textbooks «Machine typesetting » (1974), «Typography Manual» (1985) and «Phototypesetting» (1986) are being used even today, but with special stress on the graphic dictionary/terms transformation, on technological procedures and also as the introducing chapters on the digital method of encoding letter characters. Textbooks have also been offered by prof. dr. Vilko Žiljak, head of the Department for Typesetting and Computers on the Faculty of Graphics Arts in Zagreb. He has written textbooks «Computer Typography» (1986) and «DeskTop Publishing» (1988). Prof dr. Žiljak, together with prof. dr. Pap as the co-author, have written a textbook for modern printing graphics entitled «PostScript» (1998) which has also been accepted as a textbook in Croatian and English. Following a number of reprints, this material introduces many areas of graphic reproduction. The Ministry of Science and Education has also supported the technological project for publishing the textbook as a digital book for PostScript graphics (project code: 00-41), and it is used as the basis for different courses of graphic prepress.

The methodology of learning about graphic technology has started to be treated as a scientific discipline only with the founding of the Faculty of Graphics Arts at the end of the twentieth century, and with the opening of postgraduate and doctorate studies. Nova znanja i uvođenje novih tehnologija pomoglo je objašnjavanju ne samo najavljenih promjena u budućnosti već i objašnjavanju prošlosti tiskarstva koja se sada može gledati iz nove perspektive koja nam omogućuje digitalni opis procesa grafičke reprodukcije. The sources for parameter values setting the experimenting with the help of modeling and simulating printing processes are found in the context of the existing knowledge on graphic technology.

Experimenting on real actual graphic processes in the execution of valuable graphic works has never been allowed because of the high costs involved, or as a part of acquiring new cognitions, nor for the needs of setting and altering production standards. Due to high production costs there is no evidence that books have ever been printed only as the means to study production process bottlenecks. Digital production models enable experimenting with workflows defined to the detail, as well as for proving the set thesis in extreme printing border areas through changing the digital model production parameters.

Computer simulation in imitating actual processes becomes the only solution for efficient learning of many-sided contents. The first step is studying technology through e-literature that has search engines, area for editing notes, for entering one's own and other notes. The program solutions allow database expansion, expansion of graphic machine database, normas database, and solution design database. All such fresh records are available to other participants in the process of learning: to mentors, students, researchers. The solution itself is based on web technology and this means that experimenting with printing models may be started, continued or certain states could be researched at any time, from any place and from any technological computer level. Mass usage improves the very system with special stress on enhancing expert knowledge database. The experimental work carried out to date has already initiated the necessity to set new thesis in the graphic production area.

The tool has been created that is used for general teaching about printing procedures and setting norms in all phases: prepress, press, postpress. Experimenting is allowed in those borderline situations that may be used only in proving the necessity for entering more deeply into the matter that is the subject of studying or learning. The program has been made to be a multi-level one. A student may set the learning tasks by himself and this is due to several reasons: they may not be clear from the logical point of view or as a possibility of carrying out a piece of graphic work. Warning points have been set in program navigation so that messages are generated when entering states that are impossible for the production process. There are general suggestions for the design of different graphic products and instructions for finding extensive text material that must be learned before continuing further researching the production of a specific graphic product.

Simulation models for research purposes

There is not sufficient knowledge on actual printing systems when there is need for us to translate them in the form of a computer model that will make it possible to simulate the corresponding real system. The following are confronted: learning methodology knowledge, knowledge on practice functioning, organization of databases and programming, experiment planning with virtual models. We are advocators of teaching in the individual learning area by using simulators produced as digital models of actual processes and supported by knowledge databases. Stress is placed on web-oriented approach to data as well as a strict closed system in the subject being researched.

It is our intention to create a virtual world with program instruments allowing setting of a thesis, after which the tools for the experiment plan are opened – for proving it or rejecting it. The goal is that the pupil/student should find themselves in the middle of their issues out of which they exit either as winners or they need to correct their initial statements. Motivation is set as the challenge when needing to find ways of solving things in new situations. To be concrete, our area is the methodology of teaching graphic technology. By mastering differences in solving an initial task encourages the pupil and makes him more secure when working in real-life procedures. Individual mass experimenting with models in computer simulation includes planning, proving, and competition. If we are only at the very beginning of practicing this method, then it is encouragement to introduce a researching relation in respect to general graphic technology teaching.

The type of teaching with the help of virtual models and the proposal for action in real-life production is called hybrid learning because the overall knowledge is the result of completely different methods. The first is on the level of a free, program, one could say – action with no consequences. Everything remains as a record in the computer knowledge databasis that may be analyzed, processed statistically, repeated with new parameter values of the system being researched. A project for action can be prepared with it by researching everything, especially the negative consequences. The cause for such a state can be found recursively. Knowledge is very broad and is made use of as a safety guarantee to enter an experiment in a real-life system.

The second method is the use of an actual real-life system for which material means will be used to a minor or major extent. Damage is possible. Such learning was prepared on models that have not been studied more or not enough. The cognition coming from this vital second phase is the key for personal proof in respect to the new knowledge values. This encourages and stimulates to have a new cycle of hybrid behavior in mastering the program. A constructive dialogue, seminar exposition of results and passing preliminary exams is the collectiveness of the students and mentors as an act of authority. This is the area for continuing individual action in teaching/learning.

There are more choices offered through digital modeling, several ways of solving tasks. With the help of the model we try to check the accuracy of the system's virtual presenting in respect to the set theory on the printing system's behavior in order to use it as a tool for manifold learning about its internal structure. Therefore, experimenting with the proposed programs has an important task: to check the set theory on a printing process's behavior.

The reasons for using graphic technology process simulation

The education system is not prepared for new procedures in graphic production. In the first place, there is no corresponding equipment; secondly, there is no experience in working either with new computers, nor programs. Modern equipment is soon becomes out of date; the time period between new program variations is shortened significantly. The necessity to have revised knowledge has become a much greater necessity in comparison to the previous manner of schooling. A graphic employee is not only a prepress worker, a printer, a typesetter, postpress worker, but also takes part in many printing phases. Specializing in jobs is applicable for short periods of time. All the things listed point towards the need to organize a completely different type of schooling that would give a graphic worker multi-discipline knowledge and fast training for multiple tasks in graphic production. How? The proposal is to introduce simulation methods into the graphic worker's schooling educational system. Printing works are in the position to need and require researching bottlenecks in production, adaptation of capacities to individual tasks, printing machine exploitation optimization, services organization, planning of computer equipment exploitation in graphic prepress and computer network configuration.

Simulation should be learned and then applied on several levels. At first let's stress that the reason for this proposal is based on the fact that all contemporary machines in graphic production are computer controlled. Due to this it is possible to separate the specific part of the machine an operator controls, and on which he can be trained, simulate production, where his influence to production flow ceases. A graphic operator handles tools that are more of the program type than electronic. He can repeat the production control procedures many times without any actual material expenses that would incur in case of actual printing, binding, and producing of a material printed form (Pap, 2000).

A student develops the simulator in two directions. The first is in creating program designs through menus at his disposal that describe the possible production structure. The installation configuration, operation imitation, equipment control, altering of the simulation models' parameters are made possible with the help of interactive animation in the space of real conditions and in the space outside of technical borders. Such program tools are installed in personal computers and training and education can be carried out in the classroom as well as work place. The second direction in developing a simulator is the production of special gadgets that have program and electronic elements of the machines in the printing works, but they do not process paper and they do not use dyes. Such units enable the students to experience physical operating of the printing process without any material expenses. The development of electronics for simulators should be directed in such a way that a simulator is controlled from a personal computer. It is necessary to abandon the idea of specialized computers as soon as possible because the method of learning through simulation methods would be too expensive and not available to schools in such a way as to have each pupil carry out simulation experiments. Our works in creating program software for producing simulation models have taken into account that the programs should be totally independent of the computer and of the analogue simulator parts, that may be, however, necessary for proper program mastering.

The reason for introducing simulation is not so much the wish to solve a set task in the optimization of some printing process as it is to expand the knowledge of pupils, students and operators in the printing industry in order to have a broader comprehension of operations that take place in printing. Furthermore, simulation enables researching systems that do not exist and are not mentioned in the instructions for printing designs. Simulators may be brought to such environments that would create great material damage in actual printing. Were such situations to take place, both the bad and the good operators would suffer; whereas simulation enables experimenting in extreme conditions. Because of security measure, a real-life system does not allow to even come close to border conditions given in machine control manuals. By controlling a printing process in border conditions the most precious experience is gained, and this is possible only by computer simulation (Žiljak, 1982). Thereby printing machines are studied that may not even exist or are not allowed, but results of such experiments guide us towards the area of printing machine development directions, or new types of organization for graphic production control. Simulating a graphic product production as a method enables periodical checking and testing of a students efficiency.

A completely different chapter of simulation in graphic technology gives us the answers to what we could gain by introducing new technologies, by building new capacities, linking with the existing equipment. For instance, digital printing machines have been designed for a shorter life than the ones for conventional printing. Due to the fact that a major part of the machines are electronic and computer parts, it is quite true that such modern machinery will be substituted in a shorter period of time. Together with changing machines and parts fresh knowledge will be introduced and new parameters for optimizing production. It is possible to carry out successfully new studying, new training if using developed and extensive program designs and the attached databases.

Modular parts of the system for learning graphic technology processes

We have proposed and have developed an overall web orientation in instructing and a communication between: teacher – student, textbook – student, with preliminary exams and seminars through one's own websites. This incorporates creating of databases for printing machine norms and regulations, graphic product and material classification. The intention is to motivate students and scientific/research potentials and to improve production and business processes in graphic production.

The possibility to integrate knowledge on norms and standards in the graphic industry coming from various sources has been created with the introduction of the XML language as a new type of media for describing and exchange of data and their reciprocal relationships as a single unique way to describe in the form of XML documents (Pap, 2003a). Conditions have thus been created for producing simulators used in learning about graphic processes. Knowledge databases have been implemented in such simulators referring to and linking: norm standards for printing machine and processes, norm standards for postpress machines and processes, graphic prepress standardization, calculation and preliminary calculation, electronic tenders, electronic job orders and communication between people and machines. Simulators are based on XML technology for programmed learning and usage of printing technology. The proposed technology enables incorporation of the overall graphic production in Croatia as well as efficient teaching/learning in graphic technology. Integrated knowledge and databases on printing processes and norm standards are available through web technology (Žiljak, 2004a).

We have implemented the usage of XML technology and relation databases in the area of creating graphic production digital standards. The results may be used by students, teachers, and pupils belonging to the graphic and printing area who need to continue their learning process or to expand their knowledge on new graphic technologies, as well as operators in printing and publishing business, users of specific graphic products, such as holography, for instance.

The goal in creating such a system is also to have the original XML technology algorithms with application in typography become public knowledge. Standards for printed products and production management control become available to teachers, pupils and students and the printing organization. There is continuous updating of knowledge and learning methods. Chapters on graphic engineering are provided that will use simulation on one side all the way to program designs, on the other side as actual simulators of the printing process, postpress and graphic prepress. The first task that had to be fulfilled was to produce a database and an XML vocabulary for setting norms and standards applying to printing machines, consumables, graphic prepress and machine and manual postpress procedures (Pap, 2003b). The second task was to create a program module for calculation and re-calculation of a graphic product as well as making a database for graphic product calculations and for creating a program module for their classification (Žiljak, 2004b). The third task was to make a module for an e-job order module (Pap, 2004).

Methods on learning about typography

Experience gained on typography simulators is significant. The speed of training and mastering new knowledge is higher than in case of any procedures to date. As soon as only after a couple of hours training turns into creating virtual layouts with new designer solution. Chapters that had previously required teaching periods to be whole semesters, now take up two to three hours. It is permitted to learn on basis of mistakes. No physical printed form is produced. The skill in producing routines and subprograms is mastered completely now, and this was something avoided by graphic operators as if it was the job for specialists only because the learning of such matter created great material expenses. The same thing applies to table setting and the programs for aesthetic text setting. Actual real-life systems have merged typography and reprophotography; therefore there is a feeling of set-back in typography itself.

Simulators control the training of correct typography by warning, correcting and proposing aesthetic solutions. As a highly ranked preliminary test we have proposed for the students to write on computers using their own style, personal handwriting characters. There is a great deal of work to be done in this respect, so the initial stage of this task to digitalize one's personal handwriting has never been begun with much joy. Success is reached with persistent research work and by getting extra points. The preliminary condition is that there is personally owned computer equipment. Computers in schools, colleges are only a demonstration level, introductory designs and for taking over preliminary exams. Therefore, the precondition is that there is a society using home computers extensively, as well as the Internet and web technology. Personal digital handwriting will prove useful only in such surroundings, and thereby justify the extensive work in creating typography that will serve only its author (Stanić, 2006). Stressing of personal computers in private ownership is the beginning of organizing electronic teaching/learning, changing thus education, teachers, methodology, and it also enters the area of transforming the overall educational system.

The method of learning reprophotography

Reprophotography has always been the central point for graphic prepress, expensive in production, expensive in cases or errors. It requires expensive materials, films or make ready for «computer to plate» systems. Training was made possible only for the chosen ones, less for those in schools, and more in reprophotography departments on targeted, specialized machines. Acquiring knowledge and experience was very limited. By simulating reprophotography it is possible to master knowledge as to the use of the most bizarre tools, filters, separation and designing screening elements (Žiljak-Vujić, 2006), color management, calibration chain from monitor all the way to printed form, and all of this without material expenses. Separation and printing simulation have opened the eyes to a whole new generation of graphic operators. Steps are repeated an endless number of times, returning to previous positions and by checking and grading of quality. The «non-material proof print» is introduced. By simulating reprophotography procedures it is possible to learn comparative scanning skills by using the most diverse scanners, from the real ones to the program virtual ones, and thereby to optimize the path from the original to multilayer separation, - something that graphic operators never ventured into. Only after acquiring knowledge through simulators, going through the process of endless attempts and mistakes, the era of complex spot/process color separations begins, when only sometimes they can be observed as a print on paper. Reproduction material is so expensive that reprophotographers must be trained on simulation programs in order to master the step that means overall explaining of the knowledge on colors, paper, layout and printing.

Methods for learning of imposition layout

The job of imposition layout had always been for those graphic operators who did not have higher qualifications. Contemporary printing and printing with plates processed by computers requires top-grade knowledge and skills. It is an expensive phase and if it is not done well, there will be great damage in printing. Special sketchers must take part in the layout area and their job is to simulate printing and postpress before there is production of printed matter until it is thoroughly approved. Simulation in imposition layout is thereby used not only for the process of learning, but also as a parallel procedure before the actual printing as the basis for safe execution of a large printing run. In many cases planning and designing of the imposition layout brings graphic prepress to the initial point. Simulation proves negative sides of contemporary printing capacities exploitation.

The bad side of automation is the feeling that dwells in the conscience of all operators how errors, negligence and flippancy may be corrected before starting a large printing run. Such knowledge reduces concentration and serious regard of the operator towards his job. However, waiting for machine availability due to their necessary repairing caused by initial prepress errors is so grave that computer simulation of imposition layout may bring more damage than benefit. The only way out is in periodical certifying of operators and daily training on imposition layout simulators.

The method for learning printing

The first analogue simulators in printing have been created in the printing area itself: color flow control, control and adjustment of the print register, replacement of print form, paper feed, paper adjustment and many other items. Today simulators are developed as program designs and as the preliminary step to analogue simulators. However, many printers will rather count on their capability, skill and acquired experience than on using simulators. Only a digital printing machine equates the proof print with the run print, and it may be said that a printing machine and a machine for printing are also the training simulator. How can printing be simulated as the proof on quality when the proof is the actual print on paper? This question is a past issue. It is necessary to develop printing simulators that reproduce one print only, but under the same conditions as in large printing runs. Many have tried to develop standardization of color control in different printing processes. Although many methods have been offered, the final solution that would guarantee the oneness of the print from the same graphic prepress, but made on different machines has not been created yet.

The method of learning postpress in packaging and binding departments

Simulation models for binding, postpress, folding and dispatch are based on computer animation of modern multi-media technology. Luckily, many tools have been developed during this general multi-media movement. The first video animations without interactive participation have provided good results in schools for graphic education because the pupils could get to learn about a whole group of postpress graphic processes. Except for using a lot of time, the visiting of well equipped printing houses has not provided an adequate picture and knowledge on the diverse binding and folding systemsnand many other elements that are present in graphic postpress.

Our program tool has been developed modularly (Žiljak, 2001). The language and tools for creating interactive visual simulation of postpress processes is developed. The student is given the chance to research and create his own postpress operation path without negative consequences, without material expenses, without actual waste. This leads to the possibility of contemplating on a dynamic printing works. In the first place it is necessary to prove the benefit of the proposed configuration with the help of computer simulation, and then it is actually carried out

The method of learning about border printing areas

We have researched the activities taking place in studying with the help of virtual models in the area of planning, design and graphic product production: securities, documents, secured identity cards, money bills. These are border printing areas, but the motivation is high and the reason for a significant content of experimental computer work Document graphics consist of numerous parts and so motivates the student to enter printing processes with the help of which he simulates his original ones. Program designs make it possible to visualize designs up to the level when everything is satisfactory to such a level that it does not require special material feasibility. This area has aroused a state of competition and all of it has resulted in entering the graphic structure depths. The contest was then based on the wish of each student to create such a unique design of their own that no-one except the individual in question would know what solution was created. Such experimenting makes the student be the author of a one-of-its-kind product, and this is something that only enhances the wish for further work, study and research..

The method of imagining the development of printing configurations and processes

There is not one future in modern development of graphic technology, but a number of potential futures of development in the same way or almost the same way as in informatics technology. This hybrid teaching/learning method is targeted to have the students learn and adapt to imagining future development, to experiment with it and do research work, even though later it may prove to be a wrong assumption. It is more essential to develop imagining of future development of the theme being mastered than not to have such imagining. Those students that develop this will really enjoy themselves in asserting or negating their assumptions in respect to developments when such future does take place.

It is with this goal that tasks and problems are set before students (Marciuš, 2006) in border areas of graphic technology, i.e. in contemporary conditions of insoluble problems. By imagining future technologies that do not have limits, as for instance in respect to speed parameters, process, resolutions and formats; new virtual models are derived that may be tested and studied. The student begins to install hypothetical machines and graphic technology methods into simulation models, gives them their special names, and joins completely new standards of communication in order to link actions and recourses in ways that are almost impossible as yet today.

This highest level in hybrid teaching/learning is called «the method of imagined development». It is possible to achieve this only after mastering the existing program installed into the databasis of the simulation model and after interactive use of the model has been mastered. The student is not limited by this in respect to imagining during the program mastering, but he is thus acquainted with today's limitations in all segments of graphic technology. He can check his hypothetic assumptions as to future development by getting acquainted with the operation in the contemporary state of the model's development. This is the reason why the method of hybrid teaching/learning is of special value. It provides the possibility of studying actual real-life situations on a computer model, proving this on a real-life model and entering the level of learning to imagine future developments.

Methods for teacher and student levels

Hybrid learning with computer models and actual real systems encourages the development of creative ideas and innovative strategic contemplation in cooperation with contemporary cognition on the teaching/learning methodology not only in respect to students, but to teachers as well. By using this kind of teaching/learning other methods have been revealed like the method of using databases, answer databases and statistical analysis of such records. We are setting two levels of modeling. The first level, let us call it the teacher's level, is the method when the teacher poses an enormous number of questions of local and global character to a defined computer model and then measures the response and quality of responses for a set number of students. Four situations may occur: slow response and poor quality, fast response and poor quality, slow response and good quality, fast response and good quality. The teacher must reduce or increase the number and complexity of his questions in the model until he gets the corresponding response speed and response quality and this results in the point of mastering the program from the teacher's point of view. Such a method is necessary, but according to our opinion, not sufficient. Therefore we introduce the method of the student's level. We have defined it as leaving it up to the students to define the problems they wanted as to the set model on basis of questionnaires. We were surprised by the number of diverse problems, but more than 60% of the students are interested in solving problems coming from the area of graphic prepress, and this is logical because all possess the main contemporary graphic prepress tool in their own computers. Of course, from the teacher's point of view, it is not satisfactory enough for mastering the complete program. There are many possible situations: many questions and low complexity, a small number of questions and low complexity, many questions and a high level of complexity, a small number of questions and a high complexity level. With the help of statistical analyzers, the teacher learns about the rate of interest for certain questions, for graphic technology areas, but also for the students' wish as to the depth of analysis of the contents to be mastered. Because this is a diagnosis about the student's rate of being interested in the set goals, the teacher then corrects the results gained on basis of analyzing the first-level results from the level of the teacher's task. Correction must be made in such a way that the ratio of the wanted questions of the two proposed procedures has the value two and this sets the level of activities for the teacher and student.

Development of the hybrid method of learning with computer models and actual real systems

Students and teachers will take part in researching standards and creating digital norms and communication dictionaries in publishing processes, graphic prepress, printing processes and graphic postpress processes. We propose that the integration of knowledge on norms and standards in the graphic industry from diverse sources be carried out as a unique manner of description in the form of an XML document. The process of setting standards could be divided into four categories: defining publishing standards, setting norms and standards of the machinery (including manual work), defining standards for processes and their recourses and setting relations between them. Every process tends to be improved through the norm standards variables. It has been determined that defining graphic postpress requires the deepest and most complex informatics-based description of machines because each machine is specific in its own way for the function it carries out. Description of individual postpress machines requires setting up of functional dependency of parameters typical for the machine in question. Graphic postpress is linked with several hundred different postpress machines. The advantage in researching with the help of modeling with virtual equipment may be observed in the mastering of a significantly broader content scope, and learning about many parameters that are not available for testing in actual processes.

Teachers and students will set classifications in the digitalization area by themselves, as well as the suggested sample, color separation, text and image integration, film development, direct and indirect production of the offset plate, making the printout bitmap for digital printing, digital record individualization and the template function for processing pixel and screens and much more. The system of equations and functions will be studied that connect the variables between different phases of graphic reproduction and studying of digital norm standardization with the help of operations that have been set, process junctions and graphic make-ready recourses. Students and teachers will be able to fill in the databases themselves with mathematical algorithms and interrelations depending on the keys for standardization and graphic product classification.

We are opening the possibility to study about continuous automated production, operation processing and operation control, as well as describing the digital job order with XML elements and attributes. The students will be able to research the creation of individual designs for graphic system automation with XML interpreters in applications and facilities. The control of automatic workflow with activities such as connecting and branching XML files from graphic production process nodes (Pap, 2006) is the highest level of global knowledge in respect to graphic technology. The students will be able to study automatic setting of machines before the advised jobs arrive as well as multiple start-stop mechanisms of digital job order. During practice it will be possible to carry out measuring on three levels: process phase, sub-chains (a group of more phases), chains and the overall workflow. Values will be stored in the database for start-up calculations and production control. Those are numerical and concrete production norms and standards for the machines. A belonging XML description of the machine is created from each table with set described specificities. The XML vocabulary is defined for connecting the publishers, printers, paper distributor and postpress firms (Žagar, 2006).

The goal for introducing virtual printing house modeling is to cover many new systems that are already in use and those that will be in use when our student enters the works after completing a certain level of education. We are making efforts to prepare the student to be ready in situations that have been predicted for the future of printing. The hybrid method will become even more powerful with the implementation of new technologies into simulating experimentation, and with testing and measuring in practice. The possibilities and tasks of graphic web languages SVG, VML and XSL-FO (Pap, 2003c) will be determined. The production and grouping of graphic objects will be studied, the production of the cut path and masking path, filter effects and the making of a graphic sample. New technologies of interactive web vector graphics will be introduced and animation on the web interface, dynamic creating of HTML and WML records, as well as automation of PDF document production from the database. In this way pupils and teachers will be able to analyze and test chosen new technologies for certain operations and evaluate the tested technologies by introducing them into the knowledge database and simulation experimentation on basis of chosen targeted parameters.

Conclusion

Simulation introduces new aspects of observing the teaching/learning of graphic technologies. Traditional teaching/learning methods and training in graphic production are becoming too expensive and non-efficient. We have developed a digital system for describing printing processes. The program support is supported by databases and algorithms that describe the virtual printing works. Our proposal is to introduce the hybrid method and teaching/learning techniques into typography, reprophotography, printing and postpress with the assertion that it is the best way for a graphic operator's adequate education. Simulation remains as the most efficient method for a graphic operator's additional education even after obligatory education is completed.

The systematic quality of observing simulation in education should be included in the school program so that the operator should learn new programs on his own behalf after regular classes. The system of acquiring knowledge through the web/Internet should be developed so that teachers and students would manage creating of simulation method scenarios because only they can set meaningful and complex issues and tasks. The development of simulation in graphic education will be continued. The best way is to direct development towards visual, interactive, multi-media programming.

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