Biuletyn Polskiego Towarzystwa Geometrii i Grafiki Inżynierskiej
Zeszyt 13 (2003), str. 14 – 18

ENGINEERING GRAPHICS ROLE IN CAD LITERACY

Modris DOBELIS

Riga Technical University
Div. of Descriptive Geometry & Engineering Computer Graphics
Kalku iela 1, LV-1658, Riga, LATVIA
e-mail: dobelis@latnet.lv

Abstract. The paper outlines the importance of engineering graphics skills in the background knowledge of engineering education. This topic becomes especially important at the age of rapid economic and technologic changes in the society. An approach will be discussed about what and how we teach to develop the present-day engineering graphics communication skills in Riga Technical University in the context of general infomedia literacy.

Keywords: Engineering Graphics, CAD Literacy, Information Technology

1. Introduction

The present time could be characterised as the era for decisive leap from 2D drafting to 3D modelling techniques used in a wide range of engineering branches. Computer Aided Design (CAD) concept has become an everyday matter in architectural and civil, mechanical, electric, and chemical, etc. engineering businesses. One should realize that the accents in the essential knowledge for the students have been radically transformed during the last decade because of wide use of personal computers (PC). What is taught at the universities should provide the students with some practical contemporary skills and abilities for continuing self-education, not only meeting the curriculum needs of university academics. This is the time of rapid changes in the information communication environment. These consequences should lead to the general adoption of the new concept of literacy. However, a lot of time at the universities still is being wasted teaching too academically or in the "old fashioned" way. This partially refers to the classic academic subjects, like mathematics and physics.

Today the potential employers want the graduates to be a high quality professional at once, the situation which is very unlikely to be accomplished in a short training course and with little effort. The general trend seems to be that the students in the future will spend even less time in formal classrooms. Instead more opportunities will be given to the students to study at any convenient for them time and place, and what is more important - at the pace an individual person can perceive it. The new requirements produce the necessity to develop completely new graphic communication curriculum using new possibilities offered by the information technologies.

2. History of Graphic Communication

According to the Merriam-Webster Dictionary, the English term 'literate' dates back to the 15th century and originally meant 'educated' or 'able to read and write'. Literacy is characterized as a quality or state being literate. Graphic literacy origins could be dated back to much earlier time. Various kinds of drawings have been used for thousands of years to express the ideas or characterize the designs of objects to be represented or built. The media these drawings were created on was changing all the time according to the technological achievements – from cave walls in the ancient days to parchment, papyrus and paper later.

The ideas – written or drawn - could have been conveyed to a large number of people more easily using paper media. The skills to express design in engineering way by drawings

ISSN 1644-9363 / zł 15.00

have been trained to the students systematically at least for last several centuries. At the end of the 18th century a French mathematician Gaspard Monge published the theoretical principles of graphic geometry in his famous book *La Geometrie Descriptive*. The basic principles, which were used practically in this field for a long time, were formulated as a science only later. What is literacy and particularly the graphic literacy, has not changed much during one generation at that time.

3. Infomedia Literacy

The development of computers in middle 50's and 60's of the past century signalled a new era for both the way of production and media of drawings. The overall trend now is the switching from print-oriented industrial society to the digitally-oriented information society. Instead of paper as the basic media of information carrier still ten years ago we are facing a large number of new media environments provided by digital technologies. The new communication systems, particularly the internet, bring unimaginable increase in information exchange and extremely enhance the efficiency of that exchange. Infomedia literacy nowadays is defined as the ability to critically process (analyse and select) written information, sound, images, graphics and values transmitted by all kinds of new computer assisted multimedia technologies [1]. However, this definition fails to include the second part of the traditional meaning of the literacy, which is 'being able to write' or to produce this information.

The present infomedia technologies are developing extremely fast. These technologies very often outrun the literacy competence even for some technologically oriented individuals. It becomes very difficult to define who can be recognized as an infomedia literate. As the most important advantage of the infomedia technologies is bi-directional and decentralized communication, new and better ways of education such as resource based learning, virtual reality laboratories, etc. However, infomedia attracts still great deal of concerns and criticism. The most important one is the time spent by young people on the new media resources.

4. Graphic Literacy

It is widely known fact that learning drawing basics enables the student to develop important spatial imagination skills, such as perception of edges, planes, spaces, and relationships between objects. These are crucial components for creating computer models, because a large number of contemporary engineering databases deal with 2D or 3D geometric information. Additional workload lies on educators taking into account the fact that the traditional paper media for those models for some time has been changing to a new digital media, and an urgent introduction of new additional material in computer science curricula is required [2]. Another important idea is that the role of programming knowledge becomes an important expertise factor not only for computer science graduates but for many others involved in engineering and science, including even those in arts.

The engineering graphics subject has been recognized as the essence of the engineering language for a long time. In turn, the descriptive geometry is a grammar of the engineering graphics. In the past century the basics of graphical communication skills were quite widely taught even in the secondary schools. However, about ten years ago the general trend in the secondary education in Latvia led to the withdrawal of many science and technology oriented subjects from the school programmes. More attention was paid to the general computer literacy but basically it was limited to internet 'surfing', text and spreadsheet processing skills and sometimes painting activities rather than drawing. The technical universities are facing now with the graphical illiteracy twofold. Firstly, the fund of preliminary knowledge in engineering drawing and the skills in spatial imagination of the enrolling students are constantly decreasing every year. The survey performed at the Riga

Technical University in 2001 show that 49.5 % of the 1st year technical university students did not have in their pre-university education any subjects intended for the development of spatial imagination and perception [3]. Secondly, the share of the subjects dealing with the graphics communication ability development in the university student curricula has considerably decreased over the last decade. This was the result of the underestimation of the engineers' creative role in the design process and the overestimation of the role of PC which led to the famous misconception of some academic officials that "the computers will do everything".

5. CAD Literacy and the Problems

New technologies facilitate the introduction of new design concepts. The 90's of the past century outlined the switch from sequential to concurrent design approach in Computer Aided Engineering. Much higher design productivity is achieved using progressive 3D CAD systems, including parametric design technologies. However, the initial stage of the introduction of every CAD is usually followed by a slight decrease in the productivity because of the training required (Fig. 1). Successful CAD technology application allowed exceed the traditional design productivity. When a new version comes out, a slight decrease is noticed again because of the retraining required to study new concepts and features provided by higher performance of both the hardware and software. After 12-24 months the process is repeated again, and so on. It is not as problematic for those who are all the time in this business as it is for those who are completely newcomers. The designers are facing the latest versions of CAD skipping all the previous ones and become overloaded with a huge amount of totally new information and concepts. The success of mastering these technologies highly depends on the background knowledge of the users.

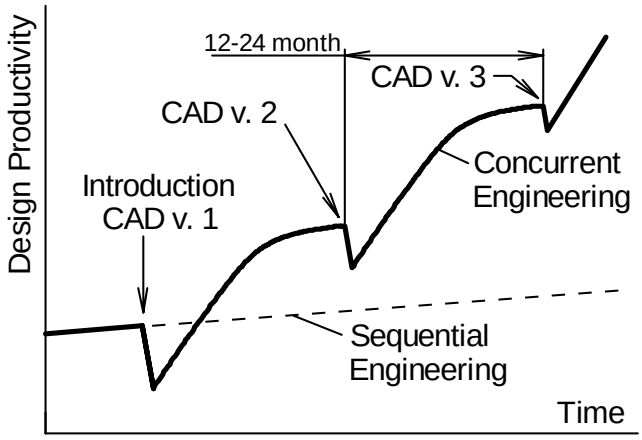

Fig. 1. Design Productivity Using Sequential Engineering and Concurrent Engineering.

Many countries in Europe have too small market for localized CAD versions to be issued. Generally software with English interface is used in most cases. The students are not literate enough to understand the special terms in English because of poor background in general computer knowledge, engineering graphics and foreign language. The general computer and foreign language literacy level is slightly increasing each year. However, a considerable knowledge gap still prevents from successful mastering progressive technologies in full scale without outside help. The students are not eager to read the voluminous manuals and study by themselves.

The present situation in the technical universities in Baltic States (Estonia, Latvia, and Lithuania) in teaching engineering graphics and CAD subjects could be characterized as the reproduction of fragmented pieces of knowledge about the new technologies and processes which are very often separated from the general context of infomedia. The absence of strong education policy in some countries in general and the local policy of the study program holders at the universities in particular, has leaded to the situation when graduates do not possess some important skills that the labour market demands. As a result, the relative amount of credit hours for mathematics in engineering studies remains the same as ten years ago causing a serious disbalance for new infomedia knowledge not defined yet as a generally adopted science. Aging of the university staff is not the last factor to mention.

6. Case Study: Riga Technical University

The course of Descriptive Geometry and Engineering Graphics for civil and mechanical engineering students in Riga Technical University is limited to 2 credit points (CP) or 32 academic contact hours. The subjects covered are: point, line and plane in space, auxiliary plane, some positional problems like intersection of spatial geometric objects. Engineering graphics deals with the basic standards, projections, sections, axonometric, sketching, and dimensioning. A practical exercise introduces to the computer modelling and clearly demonstrates the importance of descriptive geometry principles in CAD applications. Another 2 CP are allotted for civil engineering drawing and computer graphics. We are trying to let the students solve some practical problems in a new and more attractive way. The Geometric Description Language (GDL) as a part of one of the most advanced CAD systems ArchiCAD requires the integration of the knowledge obtained in math and programming classes with a visual skill development through descriptive geometry and engineering graphics subjects [4]. The attractiveness is achieved through the friendly software interface. Parametrically customizable 3D models can be easily designed which can be explored and proved for correctness in a visual way by the student itself without the tutors' interaction.

We have translated some interactive multimedia e-learning materials for architectural and civil engineering students aimed to teach the contemporary skills for several CAD applications. One of the most efficient ways of training includes the elements of watching and listening and repeating practically or 'learning by doing'. We have developed our own original tutorials for training ArchiCAD software. The idea is to guide the student through the predetermined scenario of a complex task and after completing several steps of the design stage to let the trainee to check the results against meeting certain requirements. If there is a discrepancy with the expected result the sources of the possible mistakes have to be analysed and eliminated. The scenario has been designed to force inattentive students to make as many mistakes as possible. In other words, the students are misguided with the intent to let them understand, memorize and accomplish properly maximum number of training topics.

7. Conclusion

1. Many study programs in contemporary engineering are too fundamental and little time is allotted for mastering practical skills. 2. General recommendations for CAD curricula development in context of infomedia literacy would be helpful. 3. Mutual efforts in the design of e-learning materials and environment for training engineering graphics and CAD, and exchange of experience between universities would increase the efficiency and cut the costs.

Bibliography

[1] LEE A.Y.L.: *Infomedia Literacy. An Educational Basic for Young People in the New Information Age*. Information, Communication & Society. 1999, Vol. **2**, No.**2**, 134-145.

[2] CHALMERS A., CUNNINGHAM S.: *New Media and Future Education*. Proc. East-West-Vision International Workshop & Project Festival Computer Vision, Computer Graphics, New Media. Graz, Austria 2002, 67-74.
[3] DOBELIS M.: *How and to Whom We Teach? To Study, of Course*. Seminar "Plain and Attractive About Complex". Riga, Latvia 2001, 4-8. (In Latvian).
[4] DOBELIS M.: *GDL – New Era in CAD*. Proceedings of the Sixth International Conference "Engineering Graphics BALTGRAF-6". Riga, Latvia. – 2002, 98-203.

Recenzent: dr inż. Renata A. GÓRSKA

Wpłynęło do Redakcji w czerwcu 2003 r.