XV International Conference "Linguistic and Cultural Studies: Traditions and Innovations", LKTI 2015, 9-11 November 2015, Tomsk, Russia

Pedagogical Aspects of Applied Software Packages and Computer Technologies Use in Student's Education

Yury Dementiev, Lev Burulko, Elena Suvorkova∗

National Research Tomsk Polytechnic University, 30 Lenin Avenue, Tomsk, 634050, Russia

Abstract

Special software development is necessary for successful realization of teachers and students activity. There are two directions of such software development: first is for training process organization and second is for software use in education. General ASP purpose are universal software products intended for user functional tasks operation and it is also widely used in educational process.

1. Introduction

At present time, the computerization of all spheres of human activity and computer modeling are widely used as a learning tool of reality, automation of design and training processes.

Mathematical idealization of events at investigation of various systems, application of logically interconnected actions for the fulfilment of tasks, the mathematical modeling based on applied software packages (ASP) opportunities for computing techniques become effective and reliable tools of formation of students' professional engineering thinking and cognition culture development.

So the computer (computer technologies) use reasonability in educational process is evident and actual (Postnikov & Syroeghkin, 2001; Bogoyavlenskaya, 2005).

∗ Corresponding author.
 E-mail address: suvorkova_elena@mail.ru (E. Suvorkova).

2. Modern Education Contradictions

Computer (information) technologies from the didactic point of view have great opportunities in acquisition of abilities to set and solve an applied problem in educational process. These technologies deal with use of computers and the software for storage, transformation, protection, processing, transfer and receiving information.

Therefore, they allow resolving a number of contradictions existing in modern education to some extent, which include (Aristov, et al., 2007, 2008):

1. A contradiction between process of knowledge production at all branches of science and technics and process of the knowledge consumption connected with transfer, cognition and development of this knowledge;
2. A contradiction between the requirement of fast, easy and high-quality necessary knowledge acquisition and the appropriate methods lack of development and ways of educational and informative process at specialists (engineers, technicians, etc.) training creation;
3. A contradiction between the necessity of applying a mathematical modeling method, as modern method of knowledge studying technical and special disciplines, and methodology lack of its application in educational process;
4. A contradiction between fundamental preparation and use in educational process modern "computer mathematics" and absence in educational programs for the concrete directions of specialists training consistent with modern branches of mathematics (Dyakonov, 2001).

Computer technologies implementation in educational process can become a basis for establishment of essentially new form of continuous education, supported by computer means (Doering, et al., 2009).

3. Main Directions of Software Development

Educational process transfer to computer technologies assumes special software development that is necessary for teacher and student's activity successful realization. Now it is possible to distinguish two directions of such software development. The first is connected with training process organization and the second with use of developed software in education.

The functional use of first direction is to direct interaction between teachers and students on mastering the tutoring knowledge and professional competences, development of students' individual abilities in concrete disciplines.

It is connected with a choice or special development, according to the solved didactic task, computer or other information tutorials, with program development and program-methodical documentation of necessary disciplines description and strategy of student's career education for a certain direction and specialty. The main pedagogical aspect of this direction is to provide whenever possible integration of knowledge production and efficiency of this knowledge transfer to the trainee with use of modern knowledge methods, allowing to increase educational process efficiency. Thus, there is a possibility of permission of two first, listed above contradictions.

Let us take a closer look at the second direction connected with use of a package of the applied software packages allowing studying processes in real systems and automating the obtained results processing.

The Applied Software Packages (ASP) are complex programs intended for the certain class solution of some subject. Packages are developed to simplify the computing by teachers, students and experts of different professions, dispensing with the necessity of studying programming and other fields of knowledge connected with the computer. Currently there is a huge number of ASP that cover practically all aspects of person's activity.

The second direction of pedagogical aspect is that there is an opportunity of resolving of the 3-rd and the 4-th contradiction. This use of mathematical modeling as knowledge modern method at studying technical and special disciplines, and lack of its application methodology in educational process, and with use of modern "computer mathematics" in educational process and absence of the appropriate modern sections of mathematics specialists in educational programs for the education concrete directions.

4. Classes of ASP

All ASP can be divided into two big classes: general purpose packages and specialized packages.

General purpose ASP – universal software products intended for development of automation and user functional tasks operation and they are widely used in educational process. This ASP class includes:

- editors: text (Word, WordPad) and graphic (CorelDraw, PhotoShop)
- spreadsheets (Excel, Lotus 1-2-3)
- database management systems (Access, Oracle)
- means of presentations preparation (PowerPoint)
- integrated ASP (MathCAD, MatLAB)
- design automation systems (AutoCad)
- shells of expert systems and artificial intelligence systems, etc.

In a general purpose packages class, the special place is taken by the applied programs integrated packages. They represent a multipurpose set of programs, in which various functional capabilities of general purpose package are integrally connected. The idea of unification is, on one hand, the functional completeness of complementary programs having the same user interface, and, on the other hand, opportunity to carry out all production data processing cycle on one workplace.

5. Practice of ASP Use in Electric Drive and Equipment Department Educational Process

By student's academic training at Electric Drives and Equipment Department, Power Engineering Institute, National Research Tomsk Polytechnic University, a number of disciplines, applying term papers and creative projects and also graduate qualification works, a number of applied software packages is used. In the process of studying theoretical material and performing virtual labs, a number of disciplines, such as "Professional activity software", "Professional activity methods and automation facilities", "Mathematical modeling in electrotechnics", "Mathematical modeling of electromechanical systems", "Mathematical modeling in the electric drive", "Microprocessors and the micro COMPUTER in control systems" "Imitating modeling of electromechanical systems", "Microprocessor control facilities electric drives and technological complexes", "Alternating current electric drives vector control ", "Digital control systems of electric drives" apply ASP.

On freshman classes, in studies of disciplines "Professional activity software" and "Professional activity methods and automation facilities" students use the software of eight applied programs packages. It is MathCAD 15, MatLAB 7.1 (Simulink application), Multisim 11, Electronics Workbench (Software version № 5.12), SolidWorks (SP5 Software version 2010), T-FLEX (Software version № 7 or 8), P-CAD (Software version 2000, 2001 and 2002), ELCUT (Software version № 5.7). Thus, on example of electrotechnical problems solution by using concrete ASP, they get acquainted with calculation by the analysis, synthesis and elements design of electromechanical and power systems and systems in general. However, on example of the electrotechnical problems solution by using of concrete ASP, they become familiar with calculation, analysis, synthesis and designing electromechanical components and power systems and systems in common.

Acquainting the students with ASP interfaces covered by disciplines "Professional activity software", Professional activity methods, and automation facilities the teacher notes their general construction architecture (Fig. 1). That allows understanding the ASP internal organization and a way of communication with the user.
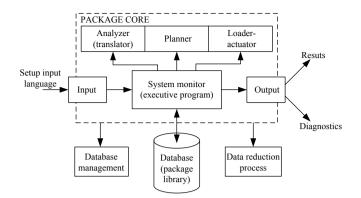
Fig. 1. Applied software packages generic architecture.

In studies of disciplines "Mathematical modeling in electrotechnics", "Mathematical modelling of electromechanical systems" and "Mathematical modeling of the electric drive" during mathematical models development and processes research in real automatic control systems, applied software packages are used, such as Multisim 11, Electronics Workbench (Software version №5.12), MathCAD (Software version № 14 or 15), MatLAB 7.1 (Simulink application). In this case, the main students attention is directed to taking decisions on various methods of differential equations systems by means of the integrated MathCAD package, structural and imitating modelling in MatLAB/Simulink and development of virtual laboratory installations by means of software packages of Multisim 11, Electronics Workbench.

In disciplines "Microprocessors and the micro COMPUTER in control systems", "Microprocessor control facilities electric drives and technological complexes", "Alternating current electric drives vector control ", "Digital control systems of electric drives" in the process of electric drives and its control systems mathematical models developing, the applied MathCAD programs (Software version № 14 or 15), MatLAB 7.1 (Simulink application) are used.

Disciplines "Computer technologies in science and education" and "Imitating modeling of electromechanical systems" are studied by masters and the main purpose of this study is to teach students how to use and apply computer technologies for deep studying of the physical phenomena in electromechanical and power systems and to carry out necessary researches with receiving quantitative results (Arnold, et al., 2006).

Table 1 - Results students study in a method of mathematical modeling.

Study programmes	ASP	Year	Number of students	Study Results			
				Know	To have skills	Be able to	Competences
Bachelors	EWB, Excel, SolidWorks, ELCUD, MathCAD, MatLAB, T-FLEX, P-CAD	1,2	2000	bases of mathematical modelling	during mathematical models development by means of ASP	to solve the elementary electrotechnical problems	ability to perceive information, goal setting and selection of ways to achieve it
Bachelors	ELCUD, MathCAD MatLAB, T-FLEX, P-CAD	3,4	1500-1800	how to develop mathematical models of electromechanical components and power systems and systems in general	research processes and phenomena by using mathematical models	to carry out the analysis and synthesis by results of the researches received by modelling	readiness to acquire new knowledge with use various means and technologies of study
Masters	MathCAD,	5,6	500-600	electromechanical	in development of	to make	1. readiness to

MatLAB,	and power systems mathematical models developed in ASP	user programs for carrying out electromechanical and power systems complex researches	recommendations about modernization and improvement electromechanical and power systems by results of complex researches	participate in research of power industry and electrical equipment objects and systems 2. readiness to study and make use of domestic and foreign experience in research activity

Practice of ASP usage in educational process of "Electric drive and equipment department" along with educational programs theoretical materials disciplines studying forms cognitive independent activity of students (Dyakonov, 2001).

Thus on the first and second courses students apply laboratory works on disciplines "Professional activity software" and "Professional activity methods and automation facilities", gain skills of the first cognitive independent activity level. In other words, having a sample of the performed task, the student makes computer modelling and researching the process, the phenomenon or object independently.

Students get the second level of informative independence performing individual tasks, writing papers and making conference – week presentation. This level is called productive and shows that it requires from students some intellectual pursuits, obtained at conducting lab works with use of applied software package.

The third creative level of student's informative independence is formed on senior courses while performing academic year projects and final qualification works. The disciplines study results analysis, within this research showed, that application of ASP and computer technologies allows to form such students abilities (the characteristic of thinking) as: to analyze (49.42% of the students participating in poll), to systematize (27.91%), to generalize studied and to make conclusions (45.35%), to think independently (26.16%) and others. This is evidenced by the fact that working with ASP and computer technologies demanded the non-standard creative decisions from trained acceptances (at 28.49% of students fully, and at 29.07% to some extent). It follows that the learning environment created by the application of ASP and computer technologies, fully contribute to the development of students' creative thinking, and orient them to find non-obvious relationships and laws to address the problems arising in the course of studying the discipline of educational material.

Thus, the mathematical models developed by the student by applied software package are directed on studying and research of processes in concrete objects in one form or another, and on studying of the physical phenomena in electromechanical and power systems.

6. Conclusion

Thus, use of applied software packages and computer modelling in educational process is an effective and reliable awareness instrument of the professional competences developed by students, and also the main pedagogical aspect of cognitive independent activity formation.

Acknowledgements

References

Aristov, A. V., et al. (2007). Mathematical modelling method usage in further vocational education. *Modern high-tech technologies, 1,* 31-33.

Aristov, A. V., et al. (2008). Electrotechnical discipline statement by means of modeling and intersubject communications. *XIV International Research and Practice Conference of Students, PhD Students and Young Scientists "Modern Technique and Technologies"*, 413-415.

Arnold, L., et al. (2006). Student portfolios and software quality metrics in computer science education. *Comput. Sci. Coll., 21(4),* 42-48.

Bogoyavlenskaya, A. E. (2005). *Student's cognitive independence development in didactics' modular-block training: study guide.* Tver: Tver State University.

Doering, A., et al. (2009). *Integrating Educational Technology into Teaching*. Upper Saddle River, NJ: Pearson Education.

Dyakonov, V. P. (2001). *Computational mathematics. Mathematics*. http://www.pereplet.ru/obrazovanie/stsoros/1161.html.

Postnikov, A. V., Syroeghkin, E. V. (2001). Universal integrated systems use of calculations automation and design on a personal computers platform in electromechanical devices and systems modeling. Devices and systems. *Management, control, diagnostics, 8*, 59-66.