



Digital economy and digital society

**edited by Tetyana Nestorenko
and Magdalena Wiezbik-Stronska**

**Series of monographs Faculty
of Architecture, Civil Engineering
and Applied Arts**

Katowice School of Technology

Monograph 22

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Part 2. Educational and psychological issues of the development of the digital society

2.1. Competence oriented tasks in the course “Programming”

Introduction. The Bologna reform introduced the substantial structural changes in the system of national higher education. Nowadays, the task of high school is to form scientific worldview among students as well as the system of modern professional knowledge, the development of creative abilities, professional qualification. The process of training should focus on the step by step creation of the appropriate knowledge system, certain skills and abilities, key and professional competence, namely, in the sphere of information and communication. The competence exactly is a criterion which allows determining the level of a graduate readiness to work professionally.

The training of future professionals is the influence on their consciousness and activity in order to become future professionals. On the other hand, the results of training should not be limited with the acquiring professional knowledge, skill and abilities only. The process of training has to be focused on the forming of key competences and intellectual features and it will help to form the personality of a future professional as integrity¹⁹⁶. It is not enough for a modern teacher of Computer Science to have the skills of traditional technologies usage. The educational segment of Internet should be studied, the skills of computer technologies introduction to the training process should be improved, the various means of telecommunication should be applied, etc.

Methods. While conducting the research the following methods were used: the analysis of the theory of Software Development teaching at Universities, the generalization and systematization of the obtained results, pedagogical observation and pedagogic experience generalization.

Overview. Academician A. P. Yershov was one among the first scientists who started to investigate the problem of the methods of Information Science teaching in 70-80s of the XX century. His well-known works “Software Development – the Second Education” and “Where the People Who Develop the Reliable Software Come from” created the basis of the methods of Information Science teaching as a science in Soviet Union. The further active discussion of the problem of the methods of Information Science teaching led to the creation and practical introduction of the educational standards. Those standards demonstrated the existing approach to the subject of Information Science and the corresponding level of knowledge of that period of time.

The methodological system of the professional training of Information Science teachers is being improved by V. Y. Bykov¹⁹⁷, M. I. Zhaldak¹⁹⁸, M. P. Lapchyk¹⁹⁹, N. V. Morze²⁰⁰, S. A. Rakov²⁰¹, Y. S. Ramskiy²⁰², S. O. Semerikov²⁰³, O. V. Spivakovskiy²⁰⁴, O. M. Spirin²⁰⁵, Y. V. Tryus²⁰⁶ and others.

¹⁹⁶ Bulanova-Toporkova, M. V. 2006. Pedagogics and Psychology of High School. Rostov-na-Donu, Russia: Phoenix., p. 57.

¹⁹⁷ Bykov, V. Y. 2010. The Modern Tasks of Education Modernization. Retrieved from: <http://www.ime.edu-ua.net/em15/emg.html>.

¹⁹⁸ Bykov, V. Y., Zhaldak, N. V., Morze, Y. S., Ramskiy, S. 2005. Twenty Years of Establishment and Development of Methodical System of Information Science Training at School and at Pedagogic University. Computer at School and in Family. Vol. 5, pp. 12-19.

¹⁹⁹ Lapchyk, M. P. 2012. Information Computer Technology Competence of Bachelors in Education. Information and Education, Vol. 2, pp. 29-33.

²⁰⁰ Morze, N. V. 2008. Competence Tasks on Information Science. Naukovyi Chasopys of NPU named after Dragomanov, Vol. 6 (13) p. 475.

Having analyzed these researches, it is possible to claim that some issues require further investigation. Namely, the analysis of Information Science training at universities has shown that the level of information computer technology competence of the future Information Science teachers does not correspond to the modern requirements. The credit-module system of education is not focused enough on the competence forming within the course "Programming".

The purpose of the given article is to determine the role and significance of competence oriented tasks in the course "Programming", for the professional training of the future Information Science teachers.

Results and Discussion. The development and implementation of some of the elements of method system or new technologies can be possible provided that the didactic principles are followed. It has to be taken into account, that "these... principles demonstrate didactic laws and patterns"²⁰⁷. Nowadays, the high school pedagogics is not only being focused on the replacement of conventional didactic principles by new ones, but also on the filling them with new content taking into consideration modern requirements.

Let us highlight the following conventional didactic principles:

- the general principles of learning process establishment: science orientation and availability, progressivity, systematization, perspective and visual support²⁰⁸, the principle of educational learning, the principle of unity of the theory and practice, the principle of pedagogical grounding of the amount of material to learn²⁰⁹;

- the principle of differentiation and individual approach to the educational process which implies the significance of taking into account age and individual features of students (different level of knowledge, skills, abilities, different rate of material perception, etc.);

- the principle of the education content selection for every major, namely: the principle of the priority of the developing learning function, the principle of information capacity and social effectiveness, the principle of differential implementation, the principle of information capacity and social effectiveness, the principle of diagnostic and prognostic implementation, the module principle of content selection, the principle of centrism, the principle of education humanization and humanitarization²¹⁰;

- the principle of quality of knowledge, professional skills and intellectual habit acquisition. This principle requires the efficient system to analyze the results of training in the form of current, intermediate and final control²¹¹;

²⁰¹ Rakov, S. A. 2012. Test of General Teaching Competence: the Basics and Piloting Results. *Pedagogics and Psychology*, Vol. 2, pp. 27-36.

²⁰² Bykov, V. Y., Zhaldak, N. V., Morze, Y. S., Ramskyi, S. 2005. Twenty Years of Establishment and Development of Methodical System of Information Science Training at School and at Pedagogic University. *Computer at School and in Family*. Vol. 5, pp. 12-19.

²⁰³ Semerikov, S. O. 2001. Activation of Cognitive Activity of Students at Learning of Numerical Methods at Object Oriented Technology of Software Development. Kyiv, Ukraine.

²⁰⁴ Spivakovskiy, O. V. 2003. Theory and Practice of Information Technologies at Training of Bachelors in Mathematics. Herson, Ukraine: Ailant.

²⁰⁵ Spirin, O. M. 2007. Theoretical and Methodical Bases of Professional Training of Future Information Science Teachers within Credit Module System. Zhytomyr, Ukraine : Publishing House of ZhDU named after I. Franko.

²⁰⁶ Tryus, Y. V. 2002. The Peculiarities of Methodical System Design for Training the Basics of Programming for Software Engineers. *Visnyk of Cherkassy University*, Vol. 35, pp. 135-141.

²⁰⁷ Alekseyuk, A. M. 1998. *Pedagogics of Higher Education in Ukraine: History. Theory*. Kyiv, Ukraine: lybid., p. 396.

²⁰⁸ *Pedagogy* / [ed. Yu. K. Babansky]. – M.: Enlightenment, 1988. – p. 128.

²⁰⁹ Alekseyuk, A. M. 1998. *Pedagogics of Higher Education in Ukraine: History. Theory*. Kyiv, Ukraine: lybid, p. 396.

²¹⁰ Burda, M. I. 1994. Methodical Bases of Differential Forming of Geometry Abilities of Secondary School Students. Kyiv, Ukraine, p. 125.

²¹¹ Galusinskyi, B. M. 1995. *The Basics of Pedagogics and Psychology of High School in Ukraine*. Kyiv, Ukraine: INTEL, p. 24.

–the principle of the relevance of knowledge and professional skills implies, first of all, the focus on the latest scientific achievements in the selected sphere of human activity, the relevant and perspective demands on labor market related to the professional level of qualification, the providing of the corresponding conditions for training and continuous conscious qualification improvement for the whole life;

–the principle of creativity and independence of students within the process of learning covers the shift of the emphasis from the lecture course to the self-training of students at practical and laboratory classes, while developing individual scientific and research tasks, etc.;

–the principle of variability at the selection of forms, methods and means of learning. It is the development of the didactic principle of alterability²¹² and it provides a student with the possibility of reasonable replacement of a major within the direction of training and, as an exception, the change of the direction of training.

–The most of courses on Information Science over the years of its existence used to be focused on the skill acquisition in software development. Different practical and historical factors caused that. They are:

–the skill of software development was essential for all the students majoring in Information Science. Mastering the software development at the first years of study could ensure the necessary knowledge for the learning of the advanced courses (for instance, object oriented programming, the theory of software development, the logical programming, etc.);

–Information Science became an academic science relatively late, therefore, it was being identified with software development for a long time;

–the model of “the focus on software development” was supported by early curricula of Information Science. But the approach oriented on software development has some drawbacks, namely:

–the emphasis on software development by cancellation of other courses of Information Science provides the students with the reduced comprehension of the course ;

–the theoretical issues targeted at the practical material reinforcement are postponed to be trained at the senior years of study when they do not have the necessary significance;

–the software development courses are, as a rule, focused more on syntaxes and features of programming languages by excessively simplifying the process of training;

–such approach can make students think that software development is the only method of task solution by applying computer.

Despite the mentioned above drawbacks, the model with software development focus has proved its power for the recent decades.

The role and place of software development in a curriculum is one of the most topical issues at Information Science training. While training software development, there appeared the necessity to apply the methods of higher motivation for the students of computer direction as well as for the future teachers of Information Science²¹³.

Software Development as a course of Information Science is based on the design of definite algorithms for task solutions. The teaching methodology, which is targeted at independence and creativity, is a thorough process of the syntaxes and semantics ratio of programming languages, the principles of software design and the methods of their mastering. The tasks, which cover finding an algorithm and its reproduction applying a programming language, are taught within one class nowadays. It is done in order to reinforce and to update knowledge, skills and abilities. But it

²¹² Chobitko, M. G. 2006. Personality Oriented Professional Training of a Future Teacher: Theoretical and Methodological aspect. Cherkassy, Ukraine: Brama, p. 88.

²¹³ Kryvonos, O. M. 2011. The Peculiarities of Software Development Teaching at University Considering Modern Requirements. Visnyk of Zhytomyr State University named after Ivan Franko, Vol. 57, p. 132.

is not enough to form information and communication competencies of students. There is a lack of conditions for independence and search. The knowledge acquired is difficult to apply to the definite real life situations.

The application of project method, that is classically based on the wide usage of projects while training (finding solution to higher complexity tasks which is not limited with the time of one class), may help to find the way out of this situation. The mentioned above method implies the humanistic individual approach to a student and is grounded on the ideas of J. J. Russo, G. Duri, W. Kilpatric. The method suggests the individual comprehension of learning material by finding solution to a problem situation. The method of projects is characterized by high motivation, the possibility of creative ability development and independence.

The given method is becoming of more significance due to the fact, that the curricula for the pedagogic directions consider graduation or qualification project not to be obligatory at the process of software development training.

The typical features of a training project are: the purpose of a project; the methods which prevail at a project development; creative nature of activity; the kind of project coordination; the type of contacts and the number of a project participants; the time of a project development. The main components of a project are: the problem, relevance, purpose and tasks of a project, the project type, the project structure, the methods of software complex development (the specificity of software development), the time of a project development, the form of result presentation.

The observation, putting forward a hypothesis, the experimental testing, expanding the scientific world view are actively used at a training project work. The result of a project has to be tangible. It means that if the initial problem was of a theoretical character, the solution found should be specific one; if the task was of a practical nature, the result ought to be ready for the practical application. The completed project has to be defended and this may be considered as a form of control.

Every project has to be based on the algorithm design which are being learned and include the design of the own algorithm. It is necessary for the students to learn how to work with graphics by their own as well as how to establish interaction with peripherals at low level while designing a user interface.

Let us mention, that such method of training activity provides the exchange of traditional roles of a student and a teacher. While working out project, students obtain the possibility to select the environment for development independently, control the rate of work, search and learn the necessary references either in the Internet or in printed form, find the consultants on specialized forums. A teacher only corrects the activity of students by directing their efforts in the right way. Here, the actions of a teacher are of recommendation character. Besides, there is a teacher consultation schedule to control the process of work.

The future teachers of physics and mathematics at Zhytomyr State University named after Ivan Franko get the competence oriented task at the beginning of the fourth semester while learning the course "Programming". This practice has been introduced in order to overcome the contradiction between an abstract subject of scientific cognitive activity of students and their future professional activity. That is why, the students are recommended to team up into groups of 2-3 people in order to develop their own software product and to present it at the completion of the course.

The software product is "not only applications, but also all the related specifications and configuration of data required for the correct application operation"²¹⁴. It is not demanded to develop applications by using only the environments which have been learned. The experience has shown, that most of students develop their own software products within the environments of

²¹⁴ Smolkin, A. M. 1991. The Methods of Active Teaching. Moscow, Russia: Vysshaya Shkola, p. 95.

object oriented programming by learning at the same time new, more perspective ones (Microsoft Visual Studio, Android Studio, Eclipse, Java.net).

The project presentation and their defense are public, i.e. all students of the group are present and other people can be invited as well. It is important for each group to compare the development to the ones of other groups. The assessment of a project quality and every student (developer) contribution in the project is conducted by the board. It is recommended to involve the senior students to the commission board along with the teachers who deliver the course. These students have some experience in software product development. The members of the board have to assess the project in whole: the correspondence to the given task; the algorithmic complexity; the project completion; the amount of work done; the quality of user interface; the specifications.

Besides, the commission board shall determine the total score of every participant of team development taking into account the part of the project performed.

The students not only identify their potential of the level of information computer technology application by self-assessment. They also select the definite topics and directions, which allow them “to fill in the gaps in knowledge” and provide the further learning of university courses by using information computer technologies.

While solving the suggested task, the students demonstrate the skills which are the key ones for the information communication competence also known as “great seven”²¹⁵. They show how the universal skills of data search and transfer by using computer and other means of information computer technology can be integrated into the systematic process oriented on a practical task solution. This list includes: determinations (the identification of data) cover task condition determination, the necessary data identification; control means finding all possible sources of data and selecting those which correspond to the problem of the task the most; data search requires finding the necessary data source and the demanded material inside the source; integration implies comparison and matching the information of different sources, presentation of the results in proper form; estimation means the correspondence of data found to the criteria of selection and the proper estimation of the resources spent; creation means the task solution by data given or developing new data; data transfer covers the transferring of data and information by using modern information computer technologies.

The first time the students get the competence oriented task is at the class of software development as early as in the first semester. They are suggested to solve some tasks on E-olymp portal²¹⁶.

This can be possible to implement after the first laboratory works are over. When solving this task students have to:

- use one of the available browsers, enter portal E-olymp (e-olymp.com);
- to learn the portal structure;
- register on this web resource (it can be possible if a student has an e-mail box);
- find the task by the indicated number;
- make the mathematical model of the task;
- find the solution algorithm;

²¹⁵ Burmakina, V. F. 2007. Great Seven (G7). Information Communication Technological Competence. Retrieved from: <http://ifap.ru/library/book360.pdf>.

²¹⁶ Kryvonos, O. M. 2009. Organization of Self-study of Bachelors in Mathematics within the Course ‘Software Development’, Vol. 2 (10). Retrieved from: <http://journal.iitta.gov.ua>.

Spirin, O. M. 2017. Web Oriented Technologies of Training the Basics of Software Development for Future Teachers of Information Science. Mathematics and information Science at High School: Modern Challenges, pp. 62.

Vakaliuk, T. A. 2013. The Application of Internet Portal e-olimp to Software Development Classes at Universities. Information Technologies and Means of Training, Vol. 4, pp. 85.

- describe the algorithm in the definite programming language by using programming environment;
- test the algorithm (one test is given in a task text, other should be developed by a student);
- transfer the program code to the special field on the web page by using clipboard, send the code indicting the programming environment and the availability of file operator in the code ;
- finalize the algorithm in case of all test failure or the occurrence of error message and complete three final stages (error message can be of three types: compilation error; the time of program operation is exceeded, the amount of RAM is exceeded).

The students not only work with development environment in such a way, but they also use other software products. When working they are permitted to communicate and search for the necessary materials in the Internet as well as get help from other students or the teacher.

Conclusions. Therefore, students develop the complete software product and realize their possibilities when solving a competence oriented task. It becomes a certain incentive for the further learning and self-improvement. All the project activity is directed to a student at the implementation of project method. The independent selection of an optional course provides a student with an opportunity to achieve the new higher level of applying information computer technologies and consider them as tools of cognition and self-development. In its turn, this facilitates the social activity of a personality.

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Part 3. The role of information in the development of the economy: industry aspect

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