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IN WHAT WAY SHOULD MODERN COMPUTER SCIENCE TEACHERS IMPROVE THEIR TEACHING SKILLS TO DEVELOP STUDENTS' KEY AND IC COMPETENCE?

The article focusses on approaches to key and IC competences formation that is a combination of modern teaching trends and authentic teaching approaches to education based on competences structure.

Key words: *IC competence, competency tasks, level of competence tasks, model of competence task.*

Today's requirements to a specialist have been formed under the influence of the situation on the labor market, accelerating the pace of development of society and the widespread of information, cause replacement of authoritarian and reproductive education oriented at obtaining knowledge by the system of productive collaboration and communication, including networks, for development and production of new (objective or subjective) knowledge [1].

Competence-based approach is interpreted as one that not only affects the structure of knowledge, but also the quality of education in general [2]. Taking into account, that the quality of specialist training largely depends on the ability and willingness to use ICT to obtain the necessary knowledge and produce new knowledge, IC competence is regarded by scientists as a key [3]. International organizations that are currently working in the field of education, in recent decades have been studying the problems associated with the emergence of a competence-based education; among them are UNESCO (UNESCO Recommendation 2013), UNICEF, UNDP, Council of Europe, European Commission, Organization for Economic Cooperation and Development (OECD), the International Standards Department and others. The issues of implementation the competence-based approach in the education system and the formation of information competencies are discovered in a significant number of scientific publications [6–8; 10–17].

However, the need to develop a system to support a process of acquiring IC competences by the subjects of educational process (pupils, students, teachers, coaches), including forming a system of competency tasks and methods of their use in the learning process, does not lose the relevance.

The purpose of this article is to analyse approaches to IC competence formation through a system of competence-based tasks, to identify the features of computer science teaching structure according to modern trends and teacher's professional qualifications.

The study of students' IC competence is a synthesis of modern education trends and authentic approaches to competence study structure. In particular, the WISE (Worlds Innovation Summit of Education) participants from over a 100 countries identified five prominent education trends:

– educational social media flourishing;
– mobile interactive education software development;
– introduction of cutting-edge class work structures;
– students' massive involvement into distance learning;
– spotlight attention to STEM education and integration of liberal arts training in order to advance critical thinking, creativity and problem-solving skills.

All of the above mentioned trends demand new methodological approaches aimed at a new type of student. For not only tools of education are important, but the very environment of education, the participants' collaboration, methodological approaches, that implement not only the knowledge transfer but the formation of competences: subject and key, skills of motivated learning. The development of education tools has triggered the development of education technologies (*Figure 1*).

The school has to change according to the global education trends and constant changes in ICT: learning for everyone, everywhere and at all times (m-learning, 1:1 model learning, one to many devices transfer), implementation of dynamic teacher-devised, student-devised and other participants-devised materials, personalized learning, game-based learning, virtual tutoring, educational services; couching, same-time cloud-aided collaboration (material access 365/7/24, real time evaluation, learning automatisation and information-proof technologies).

Cloud-based technology of "smart learning", an adaptive technology that provides personalized learning the trajectory of which is built on a certain student's achievement data, is at the stage of establishment nowadays. One of the adaptive technology tools is a system of competence tasks and the methodology of their solving.

Scientists distinguish substantive and key IC competence. Key information and communication competence is an ability to use effectively ICT in teaching, research and daily activities for solving information and professional problems. Subject IC competence is determined as an ability of a pupil to apply in a particular life, educational

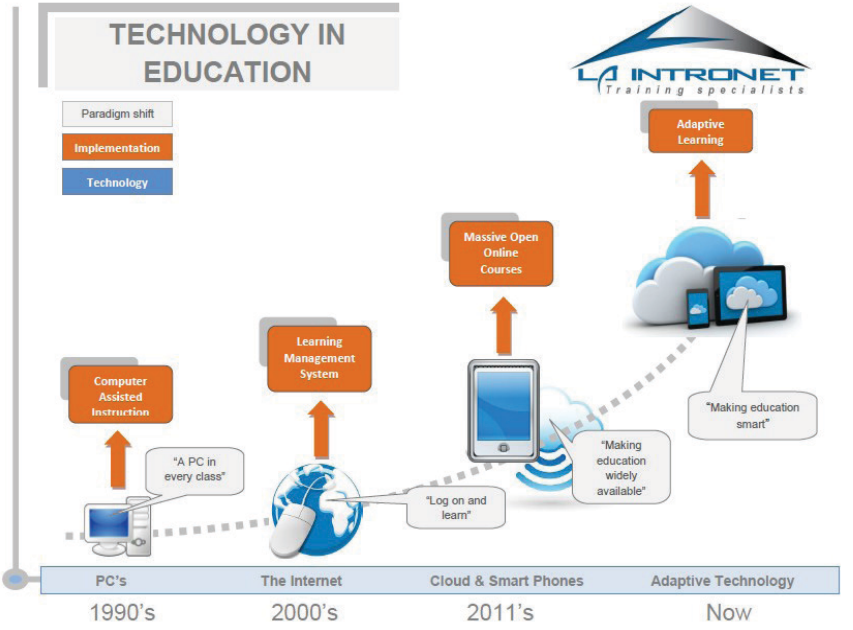

Fig. 1. Education technologies development
(*Source:* http://www.laintronet.co.za)

and research situation, including problematic, acquired knowledge, abilities, skills, ways of working for selection of appropriate ICT and their usage for searching the necessary data, analysis, organization, conversion, storage, transmission of ethical and legal norms and solving problems in subject area.

Formation of IC competences involves the development of universal critical thinking skills, including the ability to observe and make logical conclusions, using information models, to analyze the situation, to understand the overall content of the message and its hidden meaning. These competencies include the following components (skills and abilities):

– the ability to search, collect, create, organize electronic data, systematize received data and concepts, the ability to distinguish subjective from objective, real from virtual, relevant from irrelevant;

– to use the appropriate means (presentations, graphs, charts, maps, knowledge, social networks) for a comprehensive understanding and presentation of data;

– to search and find needed websites and to use Internet services like forums and e-mail, and services based on Web 2.0 technologies;

– to use information technology for critical reflection of what is happening, innovation in different contexts at home, at work (school, college) and leisure.

ICT competencies also include the following attitudes to ICT: habit to use ICT independently and while working in a team, the ability to determine the value of certain data and information; positive attitude to the rules of safe and responsible online experience, including personal issues and understanding of cultural differences between people; interest to expand the horizons of using ICT by participating in various communities, including cultural, social, etc [18].

In a process of learning computer science at school or disciplines of IT cycle at the university ICT competence is considered both as a subject and as a key.

Educational activities aimed at building ICT competence involves the development and use of competency problems for which it is mandatory to use modern ICT as a mean of solving, providing multi-level assistance and evaluation criteria both as a final result, and ways of its receiving [19]. In general, the approach "from general to specific", meaning from the formation of generalized patterns of intellectual activity to their usage in a specific subject matter, is a ground of a system of development competency tasks and in implemented in practice by applying project method, appropriate selected tasks, taxonomy of educational tasks based on theory of stage formation of mental actions [8].

To form skills for solving competency tasks in the classroom it is useful to use the following tasks at various levels, from simple to complex, from the tasks aimed at the development of one of the competencies to integrated problems without a given plan of solving a problem (*Figure 2*).

Creation of integrated competency tasks that combine knowledge and activity components should include the following steps:

– description of the content of the problem situation based on previously learned knowledge or personal experience of pupils;

– formulation of requirements to determine initial and boundary conditions of the flow of learning activities;

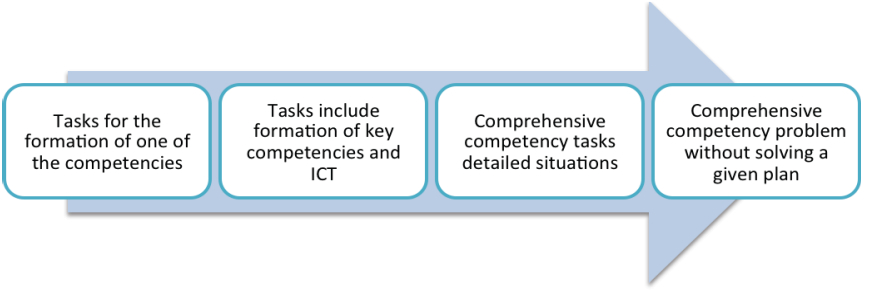

Fig. 2. Usage of competency tasks to form competencies
(*Source:* Own research)

– development of performance criteria for implementation of phases of the assignment and the resulting products of the students' activities;

– development of assistance in the form of questions, tasks or exercises aimed at the specification of the content of the situation, specification of formulated requirements, updating of basic knowledge and intensification of the association and causal connections needed to find ways to solve the problem;

– development of guidelines for quality performance of certain tasks (*Figure 3*).

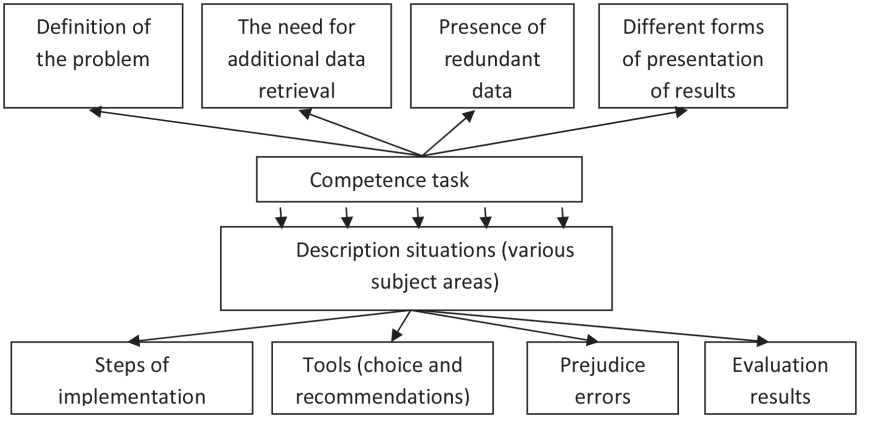

Fig 3. Model integrated competency task
(*Source:* Own research)

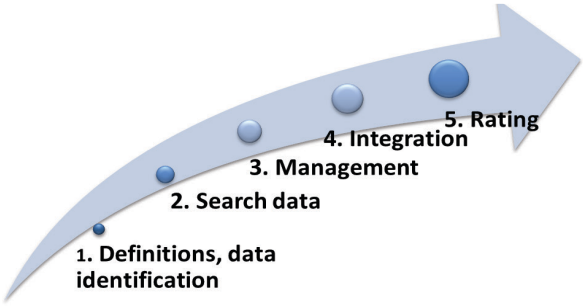

Fig. 4. Stages of solving competency tasks
(*Source:* Own research)

In problems of this type direct product is a conscious assimilation of knowledge and skills to form a strategy for solving competency tasks, plan the process of solving, monitor its accuracy and efficiency, detect and correct errors. Depending on the degree of generalization these tasks can be divided into substantive, group (that provide pair or group interaction of pupils), interdisciplinary, fundamental. In these conditions pupils exhibit intellectual activity and independence both in the process of solving, and evaluation (self-evaluation, mutual evaluation) of intellectual tasks and demonstrate the ability for goal-setting, evaluation, effective action and reflection.

At the stage of designing the process of solving by pupils of integrated competency tasks and formulating learning situations and guidelines, it is appropriate to discover a strategy for solving IT problems "big seven" [20]. This is a strategy of integration in systematic process focused on solving a wide range of practical tasks of universal skills of search and data processing by the means of modern ICT (*Figure 4*).

At the stage of monitoring the formation of competences in the process of creating and using competency tasks in the learning process it is also should be taken into account that in addition to the subject and ICT competence it is important to form life competencies that include: technology, communication, willingness to the use of information resources, self-study, problem solving and social interaction [21].

As a result of the research a system of competency tasks to implement comprehensive study of computer science and a teaching support were created:

– textbooks on computer science (published by "Osvita");

– copybooks to test competencies (published by "Osvita");
– blogs of methodological support (e.g. http://inf5-m.blogspot.com/)
– collections for the state final certification in computer science [22, 23].

The special features of formulation of various levels of competency tasks include the following:

– Computer Science (3–6 grades). *Aim:* formation of ICT competencies (propaedeutics); *instruments*: proposed by the program learning environment; *assistance:* tips and examples of implementation;

– Computer Science (7–9 grades). *Aim:* formation of IC competencies; *instruments*: a few, basis — learning environment, proposed by the Computer Science teaching programme; *assistance:* different options, tips, suggestions to justify the choice;

– Computer Science (State final examination, 9, 11 grades). *Aim:* measurement the level of IC competencies; *instruments*: student chooses the environment; *assistance:* evaluation criteria.

In a current program in Computer Science (http://www.mon.gov.ua/activity/education/zagalna-serednya/navchalni-programy.html) the school provides a solution to problems of competence, ranging from the 7th grade. Thus a teacher can choose one of two approaches:

1. competence tasks are solved with one block at the end of the course in Computer science for 7 grade;

2. while training in computer science the additional lesson for generalization and systematization of each topic where students solve competency tasks appears.

However, it is recommended to follow propaedeutics in solving competency tasks in 3–6 grades. For this purpose the following models of their usage are proposed:

– at the lesson as a comprehensive task over a series of lessons;
– at the reserve lessons as a lesson of generalization and systematization;
– as integrated practical task for domestic implementation with the current discussion and consulting by a teacher;
– as a task to organize practical training, summer camps, extracurricular activities.

The structure of competence tasks is also different. Solving of competency tasks offered to pupils of the 3–7 grades, is based on the method of selected tasks. In accordance to this method, the task

is divided into subtasks-situations that specify the principal, giving a pupil the plan for solving the problem and pointing to the development of pupil's readiness to apply the acquired knowledge and skills in a new situation close to normal living environment. Each of the proposed situations revealed in tasks that serve as the oriented basis of actions, tips to direct a pupil to the area of actual performance. For this we can offer both tests to choose one correct answer, multiple choice answers, sequencing, matching, classification etc. and tasks designed to use various computer applications and information technology.

For example, when teaching Computer Science in the 6th grade in a chapter "Computer Networks" we offer such a task: "Alina's Dad, Oleksandr Petrovych, took her with him to work. At the office Alina saw that all her Dad's colleagues were working with computers and laptops. Alina had a lot of questions how their work was organized. Help her figure it out."

Situation 1. Alina saw that Dad's colleagues were exchanging documents through a common file, and using a common printer to print out documents. Dad explained to her that it was possible due to the computer network. Alongside Oleksandr Petrovych explain to the girl how to use computers in an office.

Situation 2. When Dad's computer was booting up, two objects appeared on-screen, named Administrator and Oleksandr. Dad chose Oleksandr. Help Alina figure out what her Dad had done. Explain the peculiarities of Dad's work in a computer network.

Situation 3. To find information on the Internet Oleksandr Petrovych's colleagues use different browsers. They use different Internet services. Alina saw a lot of new things, she had questions. Help Alina find the answers.

Situation 4. Dad's colleague, Maxim, told Alina that he has a pet — an Erdelteriér. Alina had never heard of such a breed of dogs. Maxim pointed her to a website "On Dogs" where one could find information about various breeds of dogs. Help Alina find the necessary materials.

Situation 5. Alina was fond of some materials so much that she decided to make a bookmark in order to have a quick access to them later. Help her bookmark the materials.

Situation 6. Over the holidays Alina went abroad to a language camp. The camp provided Internet connection. The girl's Grandpa wants to communicate with her but doesn't know how to use the Internet. Together with Alina create tips for Grandpa.

Situation 7. Alina's Grandpa wants to know if he understood everything about how to use the Internet correctly. Help him find it out.

Conclusions

Competence task solving during Computer Science classes, on the one hand, demands specific approaches to the study structure as well as to the teacher's qualifications. In particular, the educator has to teach the students how:

- to isolate, comprehend and then put up an educational task on their own (the students master knowledge based on learning activities — comparison, modeling, analysis, change);
- to choose rational actions, ways of activity that provide learning material mastering (its skillful perception, understanding, remembering and using in practice);
- to approach the study consciously through the solving of socio-relevant, applied tasks.

On the other hand, the teacher should acquire the following professional qualifications:

- to choose applied tasks that form everyday and subject competences of students in the context of computer science topics;
- to choose the system of tips and instructions that would guide the students' agenda in competence tasks solving from data identification to results transposition;
- to understand the structure of ICT competence and choose efficient tools for its step-by-step formation.

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