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Conducting Classes On Programming At Higher Educational Institutions Applying Information Communication Technologies

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Abstract. The given article highlights the application of information technologies in education as the advanced direction of activity. The main potential of the various types of information communication technologies at conducting classes on programming, namely, the systems of sports programming contests and cloud technologies is emphasized.
Key words: task of programming; information communication technologies, programming, higher educational institution, cloud technologies.

The problem formulation. The rapid development of information and communication technologies leads to enhancing the role of educational sector when training young generation to start the professional activity and teaching programming is becoming one of the prior directions in forming the personality of a higher educational institution (HEI) graduate.

The problem of creative growth of future teachers in the process of their professional pedagogic training is becoming of more importance in terms of the educational system development and innovative teaching technologies introduction. The purpose of an information science teacher training has to comply with the General objectives of the study, education and development of a future professional which, first of all, imply the transition to a new information society.

Nowadays every higher educational institution has to focus on designing such system that would be able to cover the possibility of checking the knowledge fast and, moreover, efficiently. While teaching programming, every teacher has dealt with the problem of verifying the correctness and efficiency of an algorithm. However, the process of verifying the correctness of an algorithm or program execution is rather complex and time-consuming and can take a lot of time, if it is performed manually. That is why; there is a need to design and to apply such system which could take a matter of seconds to verify the correctness and efficiency of any program execution.

The analysis of the recent researches and publications. The contemporary scientific literature offers a vast number of researches on the application of information communication technologies to education. Pedagogic approaches to the computerization and informatization of education process are considered in scientific papers written by V.Bykov, M.Zhaldak, Y. Mashybyts, I.Pidlasyi, N.Talyzina and others. The methods of teaching programming are considered in the papers of such scientists as L.Gryshko, N.Morze, Z.Saydametova.

Having analyzed the scientific sources, it is important to mention that the problem of information communication technologies application to teaching programming has not been enough investigated and, therefore, it needs paying special attention to.

The purpose of the article. Taking into consideration the mentioned above, **the purpose** of the given article is to analyze the possibilities of information communication technologies application to conducting classes on programming for the future information science teachers at higher educational institutions.

The main material. Let us analyze the most widely used Internet portals in Ukraine at conducting classes on programming.

ALGOTESTER [2] – is the system which allows conducting not only classes on programming, but also is helpful at programming contests (see Fig.1).The given system is an extension of the well-known system ACM Contester, which is added to the new product.

Here are the main functionalities of *ALGOTESTER* application to conducting classes on programming:
1. Currently the system contains about 200 tasks due to the fact it has been used recently and its authors are planning to extend the number of tasks to more than 2000 (as it was in the previous version).
2. The given system allows creating contests by using the bank of tasks for all the participants of the educational process.
3. It contains the overall rating of the registered participants.

4. There is also a queue of the solutions which demonstrates the assignments performed correctly, the failures and the percentage.
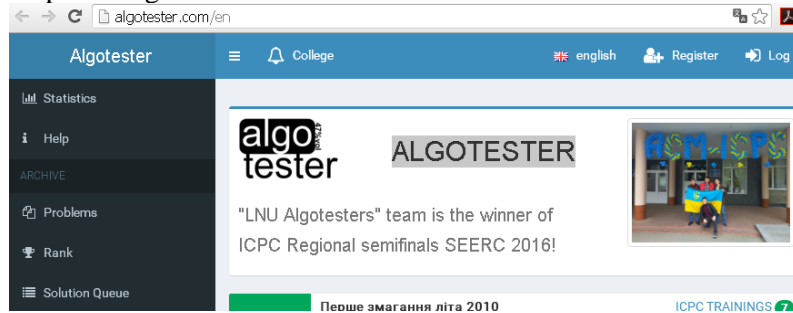

Fig.1. ALGOTESTER system

All mentioned above features are really helpful either for students or teachers. They enable a teacher to control some sections of knowledge, to conduct module tests by introducing contests. The system automatically controls the correctness of task execution and a teacher does not have to spend time to check the tasks of all the students in the group. Students can benefit from this system by self-control of their knowledge and skill progress in solving programming tasks at home using all open tasks.

NetOI Olympiad [3] – is the support center for competitions at school using Internet. On-line check of solutions to programming tasks is implemented in this system.

Here are the basic functionalities of this center:

1. There is the training section on this site which enables users to test their knowledge and skills in solving programming tasks.
2. The site contains the full archives of all previously held contests as well as the full archives of all-Ukrainian competition in information science, a lot of other information, namely, about the regional tournaments which are not widely known. It also contains the materials of all-Ukrainian contests of young specialists in information science. It gives the possibility to see a huge task base.

Conducting contests, competitions, tests in programming. It is important to mention that the given resource differs from the previous one in providing the registered participants with automatically sent tasks. The judges have the possibility to clarify the tasks in competition forum in real time. It is done by chat consulting and the schedule is sent to the participants with the task.

Internet portal e-olymp [1] (see. Fig.2) helps a teacher of information science to teach programming, to deliver optional and special courses, to consult schoolchildren and students before tests, examinations, competitions in programming of different levels, etc. It enables schoolchildren and students to solve the tasks independently and to prepare for classes and competitions. Students can also select the corresponding tasks, check their solutions without teacher's facilitating, and compare their level of knowledge and skills to other users' achievements. First of all, it encourages students to learn more about programming and contributes to the development of their self-esteem. Let us consider the given Internet portal in detail due to the fact it is used while teaching and learning at Zhytomyr Ivan Franko State University.
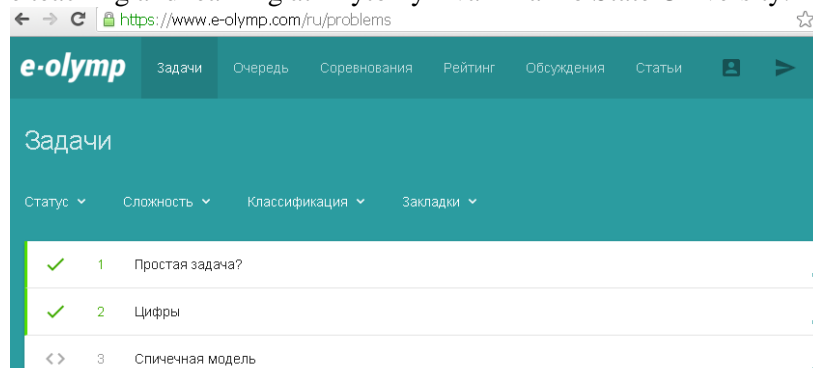

Fig. 2. Internet portal e-olymp

To get started on the portal, it is needed to register (the same as in two previous cases). It is a requirement for sending solution or participation in the competition. The menu is extended after the registration is over and a user has signed in. The following issues are added: My Profile, My Solutions, My Groups, My Messages, Edit Profile, Settings, Escape.

A registered user can see tasks on the page "Task List" (see Fig.2.). It consists of the following items: "status", "complexity", "classification", and "favorites". In this case the "status" bar is divided into: all tasks, solved, partially solved, not solved. The "complexity" bar is divided into: all tasks, very simple,

simple, average, complex, and very complex. The "complexity" bar contains the classification of tasks by the known chapters of division of tasks in programming "[4]. The "favorites" bar is divided into: all tasks, tagged, not tagged.

The page "Task List" (see Fig.2.) offers the tasks to select. A task can be either looked through or solved and as a result, the page "Task" opens. It contains task text, specifications, input and output data examples, task solution sending functionality. The bars "Solutions", "Statistics" (information about the attempts to solve the given task) and "Discussion" (communication with the authors of the tasks concerning the tasks, site administrators and other users) are also available.

Having read a task and input and output data, a user develops an algorithm of a solution and implements it within the environment of some programming language provided by the given Internet portal The system e-olimp tests the solutions implemented by such programming languages as Pascal, C#, C++, Java, Php, Phyton, Ruby, Hascell.

The tab "Send Solution" is used to send the solution to the selected task to be checked. It should contain the number of the task selected by a user (if is not shown automatically). Then, a compiler is selected. It has to check the given solution. The program code has to be inserted in the special place, the way of data input and output has to be labeled (from file or not), the button "Send Solution" has to be pressed. After this the solution is in "queue".

The system shows how many tests are scored and the type of an error for those tests which are not scored. It is performed after clicking the button "Result".

Data is processed after the solution has been tested. Overall rating of a participant is calculated and it is available on page "Rating".

The next useful page is "Competition". It contains three tabs. They are "Status", "Rules" and "Type". In this case the tab "Status" determines which competitions have to be selected from the list: all contests, planned, current or previous. It also provides the information about the competitions conducted and the results obtained. The information about current and planned competitions is also presented (these competitions are public for all users of the site). The tab "Status" enables the users to select the type of competition by the rules: by the best solution, by the latest solution, ACM. It is important to mention, that the previous system scores only by the latest solution. The tab "Type" determines which competitions to display. There can be public competitions or group tournaments.

It is recommended to visit the page "Articles" – "Help" before using the Internet portal for training or preparing for competitions. This page is devoted to the rules of using portal e-olymp.

Here is an example of solving one task on the given portal.

Task 1. Simple task.

The program reads two-digit number and outputs every single digit separated by space.

Input data: A natural number in the interval from 10 to 99 inclusively.

Output: Beginning with the first digit of a number, space bar, the second digit.

The task link is: https://www.e-olymp.com/uk/problems/1

The solution to the task is:

```
var n, a, b : integer;
begin
  readln(n);                          {number is read}
  a:=n div 10;                        {first digit is separated}
  b:= n mod 10;                       {second digit is separated}
  writeln(a,' ',b);                   {display by space bar}
end.
```

In case the task is solved absolutely correct, the screen will look like it is shown in Fig.3. The number of the tests scored will be displayed as well. The section on methodology named "Articles" was designed to help school teachers of information science, university teachers of programming, coaches training for competitions in programming to use the Internet portal efficiently. The functionality to create groups was implemented to be applied to conducting contests in programming, tests or preparation for tests.

Team leads can conduct independent competitions in programming using the tasks from the site archive. In order to create a group a team lead should send the application form to obtain the rights of a coach to the Internet portal address. The application should contain the information about the educational institution represented by the group; the number of participants in the team; surname, name and patronymic of a team lead. After this the administration of the site informs a team lead personally about the obtaining the rights of a coach or explains the reason for refusal.

In order to start competition a team lead has to use the tag "Competition" and click on "Create

Competition" which is at the right top corner of the page. The form "Create Competition" will be available. The given form should include: the competition name; the numbers of the tasks should be separated by coma and placed in the field "Tasks"; the competition beginning and finish according to the given pattern; the selected rules to conduct the competition. The field "Description" presents the explanation of the rules. The competition starts after all the fields have been filled in by clicking the button "Create" and it will begin and finish at the specified time. The team lead can stop the competition for different reasons before the time expires.
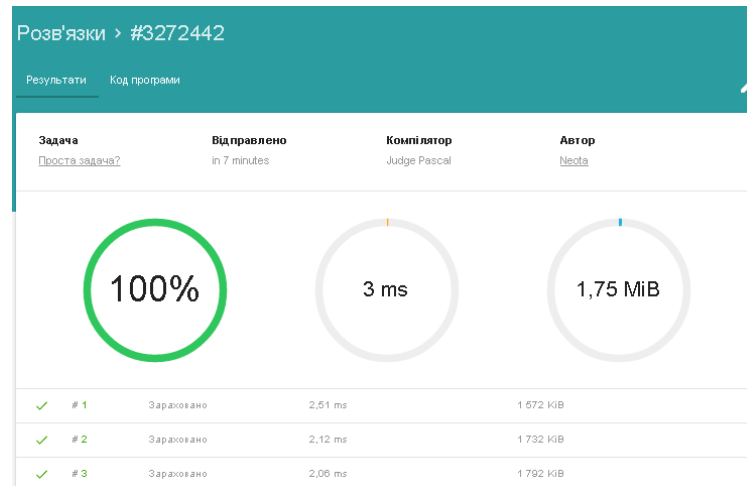

Fig.3. The example of task solution to be scored on e-olymp

The site described above is helpful not only at conducting competitions, but also it can be successfully used at classes, module course tests, examinations, practical sections of the exams, etc.

For instance, it makes possible to create a competition during out-of-class test or final semester test and to follow the results all the time (tab "Results") remotely.

It is important to mention, that the results of competition are displayed for all the participants in a group and the overall result is presented in points. It is also possible to see which tasks have been solved and the solution percentage (if the task is not completely scored). These results can be either printed out or imported to Excel.

The authors are certain that the given Internet portal is really helpful at conducting the practical section of examinations or tests while checking the correctness of an algorithm. First of all, it is recommended to prepare a practical task for every student after having checked what tasks are solved by each user on the given portal. The number of a task to be solved is given at the examination or test. The percentage of the solution scored by the system can equal the final grade for this task.

Cloud LMS. A lot of opportunities appear for all educational establishments to manage the educational process due to the increasingly growing popularity of cloud technologies. The educational platform based on cloud oriented technologies could allow the efficient use of available resources at HEI and students could benefit from applying modern technologies.

The specialized platforms called Learning Management Systems (LMS) are constantly developed to solve the problem of the deployment of systems aimed to adapt the educational process at HEI to network as well as to design cloud oriented educational environment for universities. These systems are used to develop, control and share educational online materials providing special access. The materials are placed within the educational environment by applying the sequence of learning. LMS include various individual tasks, projects to develop in small teams and educational elements for all students. The tasks are based either on content component or communication.

There are a lot of systems to manage learning which can be applied to online learning. Therefore, the learning process can take place in real time by introducing online lectures or seminars. LMS possess the high level of interactivity and allow people who are in different countries and have Internet access to learn.

Let us consider **LMS NEO** [5].It is world level LMS and it has been awarded for its efficient using at schools and universities. The platform is easy to use, it has the excellent interface and a complex set of innovative functions. NEO [5] is a LMS for using by some teachers, schools, universities and regions to provide online learning.

NEO has a wide spectrum of functionalities such as: class support, full featured grade book, curricula and learning materials, cooperation tools, etc.

NEO possesses the attractive and easy to use interface with the adaptive design for Android applications. It is important to mention, that the cloud oriented learning environment (COLE) was developed by us

applying the latter LMS to be used for Bachelor's course [6] (see Fig. 4). This environment features all the functionalities required by the scientists at universities. Some of them are: E-journals usage; online services application to educational process; mailing, online testing and knowledge assessment; opportunities for distance learning, library of books, study guides, tutorials, media files; file storages; video conferences, etc.
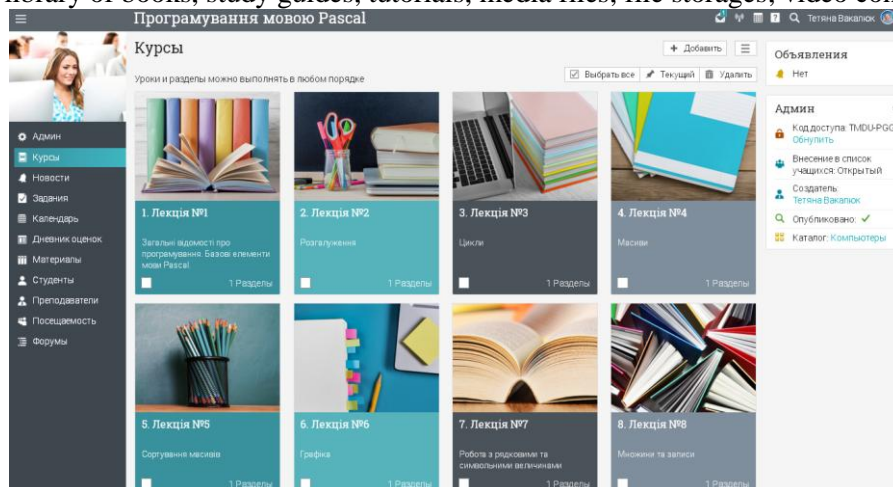

Fig. 4. Cloud oriented learning environment for Bachelor's course in Information Science

Conclusions and further research prospects. Consequently, the application of information communication technologies at conducting classes in programming is useful and efficient. The described above sites are used by teachers of programming at universities and teachers of information science at schools. These sites are helpful not only at competition in programming, but also at delivering lectures, practical classes, tests, out-of-class tests, practical section of examinations. The developed Internet portal e-olymp is designed to reduce university teacher time in order to obtain the efficient and correct checking of the solutions to the tasks in programming. The developed COLE provides all required forms, methods and learning tools, the interaction processes within COLE, which is really helpful at conducting classes at universities.

The identified problems and obtained results give reasons to believe that the application of information technologies in educational activity is one of the prior directions of further researches and this issue will be topical and will require further researches.

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Вакалюк Т.А., Медведева М.А. Проведения занятий по программированию в высших учебных заведениях с использованием информационно-коммуникационных технологий

Аннотация. В статье на основе анализа научной литературы показано, что использование информационных технологий в образовании является ведущим направлением деятельности. Показаны основные возможности использования различных видов информационно-коммуникационных технологий при проведении занятий по программированию, в частности систем по проведению спортивных соревнований по программированию, и облачных технологий.

Ключевые слова: задача по программированию; информационно-коммуникационные технологии, программирование, вузов, облачные технологии.