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CREATIVE APPROACHES TO COMPUTER SCIENCE EDUCATION

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Using the example of PPS «Toolbox of multimedia lessons «For Children About Chopin» we demonstrate the possibility of involving creative students in developing the software packages for educational purposes. Similar projects can be assigned to school and college students studying computer sciences and informatics, and implemented under the teachers' supervision, as advanced assignments or thesis projects as a part of a high school course IT or Computer Sciences, a college course of Applied Scientific Research, or as a part of preparation for students' participation in the Computer Science competitions or IT- competitions of Youth Academy of Sciences (MAN in Russian or in Ukrainian).

Keywords: *creative approaches to education, multimedia lessons, computer science education*

Introduction

In the modern world human capital and intellectual resources have become some of the most important export components for any fast growing country, perhaps even overtaking the importance of natural resources such as metals or grains in some cases. Nowadays, almost every Ukrainian family with children owns a personal computer that exceeds in its technical capabilities any of the computers ever available to the fathers of our domestic traditions in computer sciences, including S. A. Lebedev, V. M. Glushkov and others. However, these personal computers are rarely used for educational purposes, more often so for pure entertainment, despite the fact that their technical capabilities can be effectively employed to develop and advance children's and youth's computer science and programming skills, thereby contributing to the country's human capital and intellectual potential.

Computer science Olympiads and the competitions of young programmers of the Youth Academy of Sciences (MAN), which have been organized in Ukraine for about twenty five years, are in general successful in addressing an important task of country-level importance – to discover and provide state support to talented youth with exceptional skills in programming. However, the number of Olympiads' participant (so called "programmers-sprinters") and the number of MAN competitors (so called "programmers-stayers") is quite small, only about 0.001% of all students [1 – 4].

At the same time, modern information technologies can serve as an effective tool for development of creative skills of a much broader group of students, not only those who are dreaming of becoming a programmer. For example, the students in schools and colleges can develop their creative and technical skills by designing, with help of personal computers and Internet resources, multimedia educational packages on their favorite subjects. The authors of this article view such possibility as a powerful mechanism for encouraging creative young people to pursue independent scientific research [5 – 9].

To illustrate this idea in more details, let us consider the following example [10].

Toolbox for Multimedia Lessons «FOR CHILDREN ABOUT CHOPIN»

On the WEB-site of the Ministry of Education and Science of Ukraine (http://www.mon.gov.ua) a competition «**For Children about Chopin**» was recently announced. The competition is devoted to the 200-years-old anniversary from the day of birth of the composer, and is organized by the Polish Institute in Kiev jointly with the Institute of Innovative Technologies and Education of APS of Ukraine. Within the framework of the competition, innovative teachers

develop and test new multimedia methods of teaching, while actively using computers, multimedia projectors during lessons.

The Toolbox of Multimedia Lessons described by the authors enables a teacher to prepare different scenarios of integrated multimedia lessons about Frederic Chopin, taking into account ages, cognitive, aesthetic and other skills of students. The DVD developed by the authors contains different educational presentations, a collection of musical audio files, biographic videos about the composer, of total demonstration time of more than 10 hour and total volume of more that 3GB. The DVD allows a teacher to diversify teaching methods to use the teaching time more effectively. Additionally, as an example of using the DVD, the authors have also developed a student's workbook that implements different scenarios of various lessons.
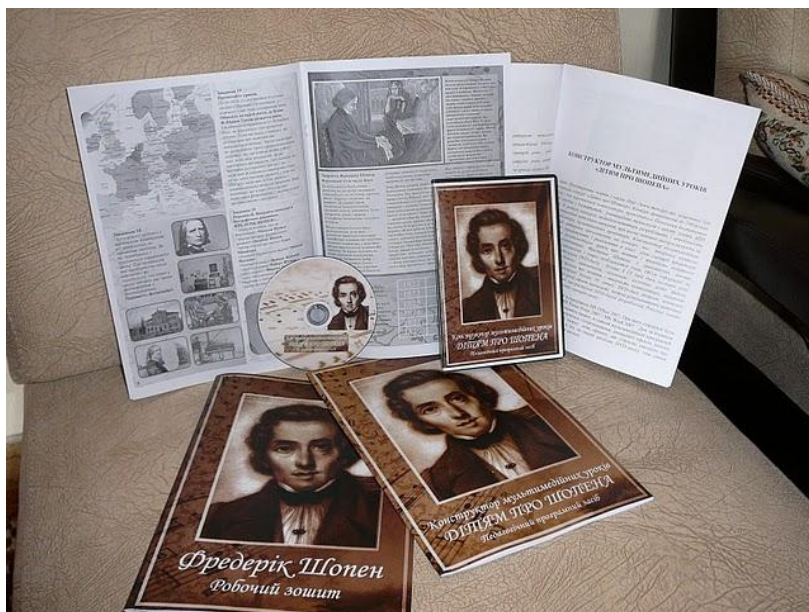

Similar educational software packages for all school subjects can be developed at schools by the students who prepare for the competitions at the Small Academy of Sciences of Ukraine in the field of «Informatics technologies». The teachers who are proficient in MS Power Point can supervise the students developing such software packages.

The DVD is developed MS Office 2007. During its creation MS Power Point 2007 and MS Word 2007 were used. Animation, navigation buttons and hyperlinks are used to connect various components of the project.

Next, to assist in navigation of the DVD, we describe the project in more details. When the main file starts, a slide show is being played, accompanied by one of the Chopin's musical compositions. The slide show presents the photos of the composer, his friends and relatives, as well as the photos of historical places linked to his name.


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Next, the main menu of the software package is opened, which includes: **Biography, Video, Musical collection, Map** (a multimedia map of Europe is the XIX century, informing about historical places related to the life of Chopin), **Quotes, Identification** (a form for students' registration), **Exam zone** (students' testing), **Creative tasks, Pictures** (an entertaining quiz), **Mini games, Links,** and **Help.**
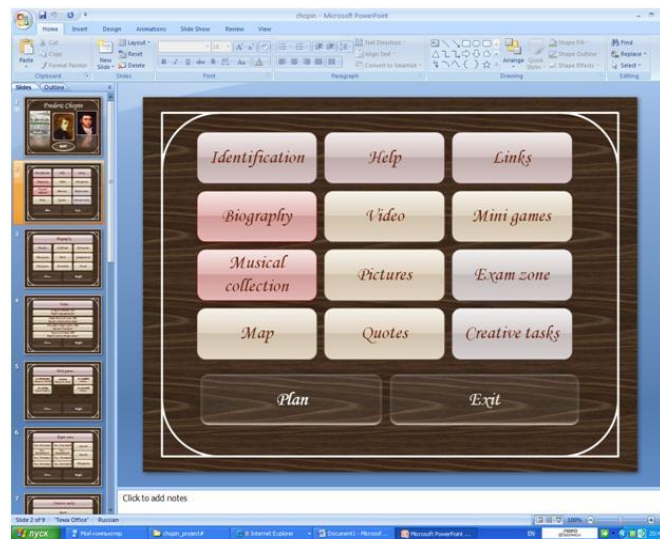

Hyperlink **Biography** opens the menu with the following commands: **Timeline** (Chronologic table of events from life of Chopin), **Childhood**, **Education** (Chopin's of studies), **Young years** (Youth), **Paris** (Parisian period of life and creation), **George Sand** (Relations of Frederic Chopin and George Sand), **Last years** (Last years of life of composer), **Memorable places, Music** (and article about Chopin's musical legacy).

Hyperlink **Video** allows a teacher to show during a lesson the followings films or fragments from educational films about life and works of the composer: «A song to remember» (1945, English; biographical film); «Chopin: Desire for Love» (2002, Russian; romantic drama, biographical film); «Free flight. Chopin's effect» (2008, Russian; TV program); «Mystery of Chopin» (1999, English; film & concert).
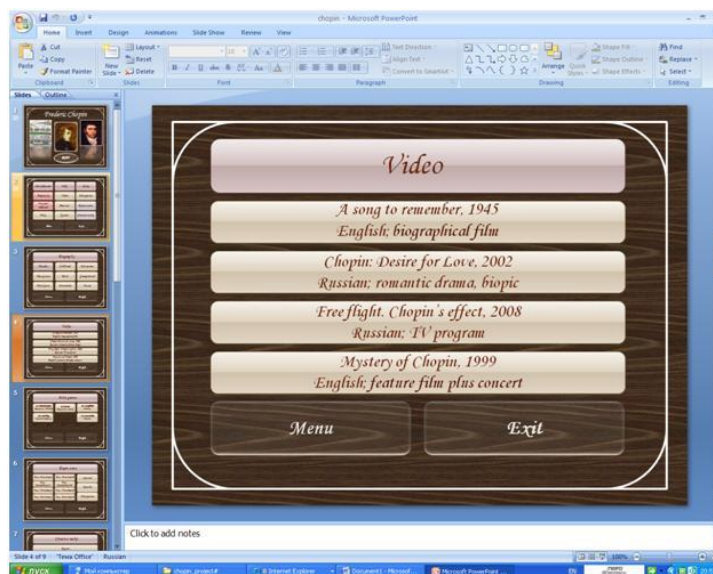

Hyperlink **Exam Zone** is designed for testing the students' knowledge and contains the questions of two types of four levels of complication.

Hyperlink **Creative tasks** opens an MS Word file containing the blank forms for students' essays. The teacher can print them out and distribute to students for independent work in class or at home.
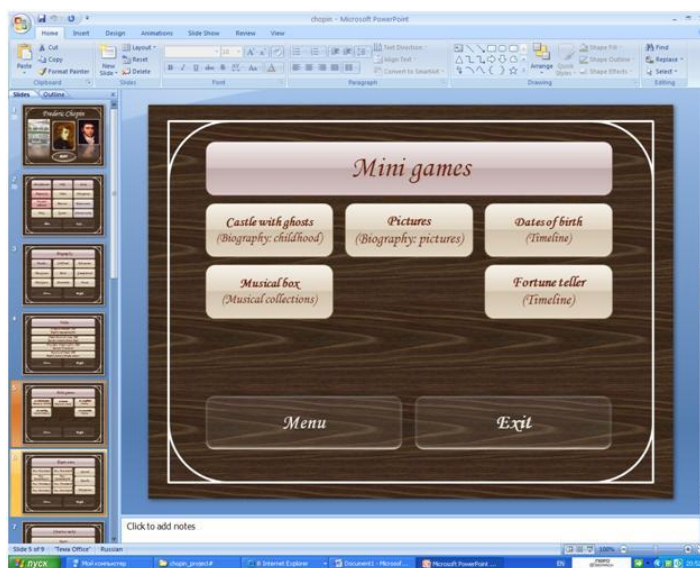
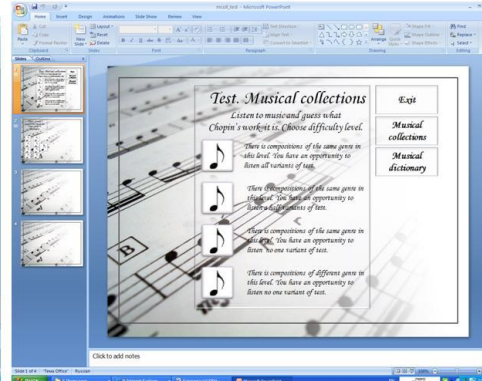Hyperlink **Mini games** opens a new menu which can be used to start a number of tests implemented in the form of computer game **Castle with ghosts** (About Chopin's biography: childhood).
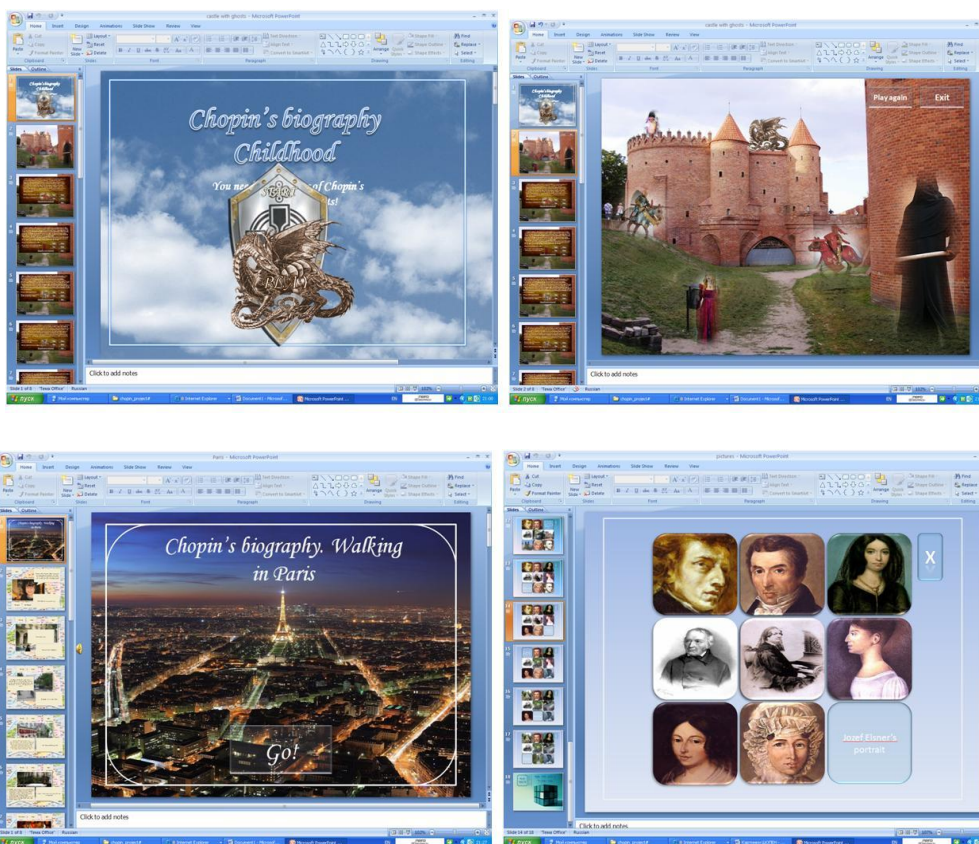
Musical box (Musical collections) is a quiz the «Musical small box»:
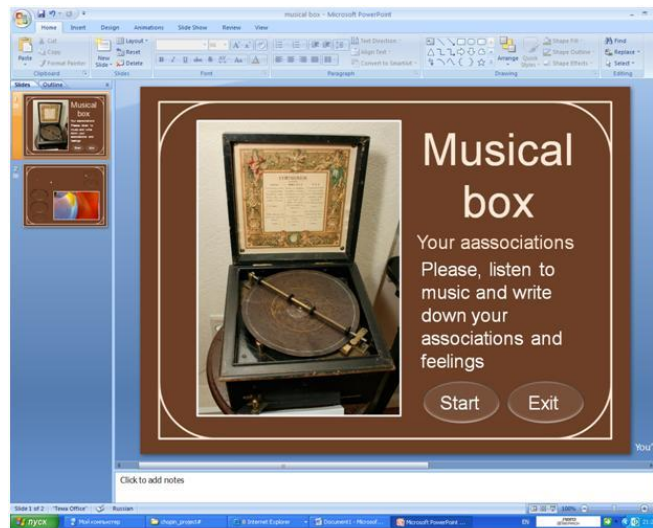
Pictures (Biography: pictures) is a quiz «Pictures and photo» («Chopin's places»):
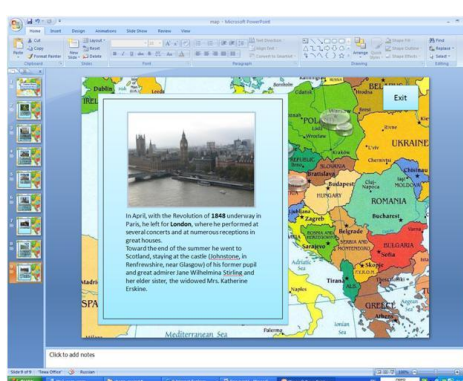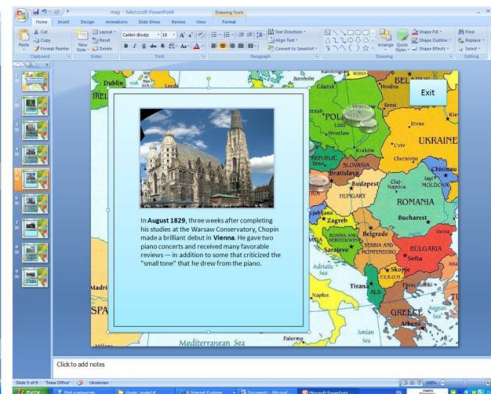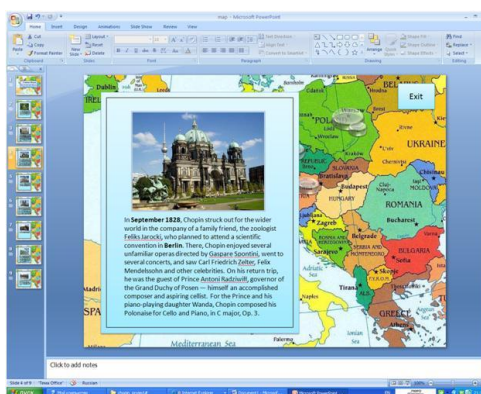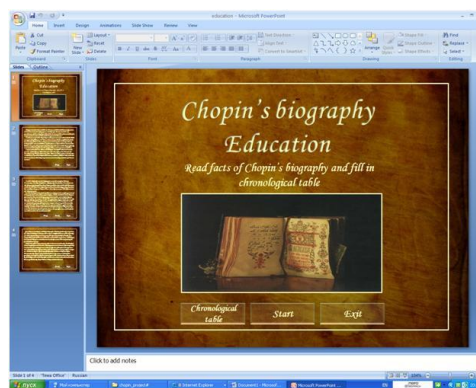
Dates of birth (Timeline) is a quiz the «Chronologic table of life and creations of Chopin»:

Fortune teller (Timeline) is an astrologic quiz «Prediction of the composer's fate».
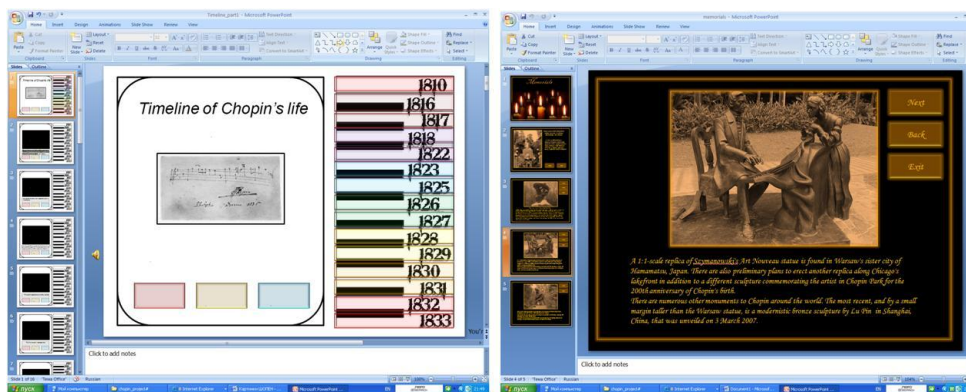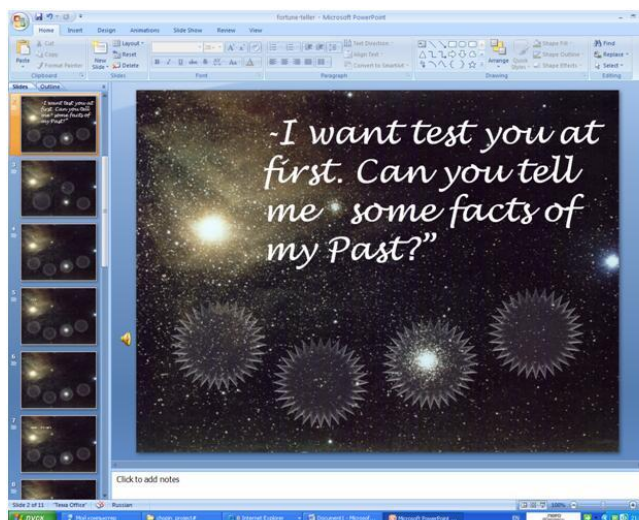

Hyperlink **Help** opens the menu of the following options: **About the project**, **Pupil's instruction**, **Information for the teacher**.

Finally, hyperlink **Links** allows the teacher to refer to the archive of documents about Chopin stored on the DVD (under a link **Archive**), to the information resources on the Internet (Internet links), to the list of literature about a composer (**Bibliography**), and also to communicate by E-mail with the authors of project (**Contact us**).

As was noted earlier, the multimedia project is designed in MS Power Point. This creates certain requirements for working with the program. In particular, MS Office 2007 must be installed on the personal computer, and the content of the DVD must be copied to drive D: on the computer. In addition, the technical parameters of the computer (its speed and memory volume) are also important for effective use of the program.

At the same time, the fact that the software package is based on MS Power Point makes the multimedia project «For Children about Chopin» open for modifications. Creative teachers, who are familiar with technology of designing similar multimedia computer programs, described by us, for example, in [5, 9], can complement the multimedia project with other component. It is also important that, in designing such new components, the teacher may involve the student, who are interested in applied computer sciences, or are preparing for the computer science competitions of the Small Academy of Sciences of Ukraine (see the list of typical works submitted for the competition at http://www.man.gov.ua/, http://www.raspopov.net/MAN/works and also works [2 – 4, 8]). For example, the students can design new slide shows, expand the collection of video and audio files, design new quizzes, games or tests etc.

After testing of this multimedia project at school, and making the necessary improvements, the revisions of the project «For Children about Chopin» can be distributed using Flash-technology.

As a result, this tutorial will become yet more reliable and steady in implementation, easily operated on the different types of the personal computers. For example, the capacity the Flash-version software will not depend on which version of MS Office has been installed on the user's computer.

The described multimedia program «For Children about Chopin» allows a lesson to be very interactive, the teacher can easily adjust the content of the material discussed in class. The use of English language in the program is an additional benefit (see, for example, so called integrated lessons «Music» + «English» + «History» + «Informatics»).

An example of scenario of one possible interactive lesson "Life and Works of Chopin" based on the discussed multimedia project will be posted on http://www.Chopin2010.narod.ru. The authors also plan to inform teachers about further developments of project on the same website [13].

Similar multimedia projects for educational purposes, but for other subject, can be designed from the very beginning at schools by teachers and students using the rich tools of MS Office 2007 [3, 7, 8].

Next, let us discuss the technology of the education and development of creative skills that has already been tested and successfully used in the Youth Academy of Sciences of Ukraine and can be recommended for use by teachers in schools, colleges and universities.

Features of The Technology for The Creativy Teaching of Informatics

The tradition of holding annual competitions on programming among the students of the capital of Ukraine has started in the Kievan Youth academy of sciences (Kievan MAN «Doslidnyk») 20 years ago, when the subject «Basis of informatics and computer programming» became obligatory at schools [8].

The winners of the competition are given advantage at being admitted to the computer science departments of colleges and universities of Ukraine. The experience of past years shows the students of Kievan MAN «Doslidnyk», who spend 2-3 years pursuing their self-education and creative research in the department of informatics as young programmers, usually become the students of leading colleges and universities of Kiev specializing in information technologies (IT).

Later, during college years, they take active part in research activity of various student organizations, and, during their senior years, easily find IT jobs in the leading companies in Kiev. The best of the MAN's ex-students move on to graduate studies, both in Ukraine and abroad.

The curriculum of the department of informatics of MAN «Doslidnyk» is targeted towards pupils of 8th -11th grades who demonstrate unusual skills and interest in programming, are capable of working independently, and are interested in developing various creative IT applications.

Our experience shows that, unfortunately, at least in Kiev, there are not many teenagers who possess the above indicated characteristics, only about 0.1-0.2 percent among their peers.

Therefore, the education of these talented children is highly personalized.

Every year, only 100 to 150 pupils participate in public competitions of IT projects in Kiev, a city with a population of over three million people.

This amount has not changed much during the last 15 years.

MAN "Doslidnyk" informally classifies its students into three categories: a listener of MAN (level I, 8th – 9th grades, the first year of education), a member candidate of MAN (level II, 9th – 10th grades, the second year of education), and a member of MAN (level III, 10th – 11th grades, the third year of education).

Younger pupils are also invited to participate in MAN departments, though there usually not many of those that decide to join.

The students are assigned algorithmic or programming tasks to complete, tailored to their skill level and experience.

An important aspect is that most of the tasks are targeted to develop students' self-organization, self-education and extensive practical training in the area of IT-technologies.

Typically, as a first assignment, to help the students express their creativity, the students are asked to develop a multimedia training program using MS PowerPoint and VBA.

In order to provide better motivation in completing this first task, the students go through a preliminary testing that helps to find out the range of their interests and tastes, so that the first assignment was maximally aligned with their personal interests.

At the same time, the students are encouraged to familiarize themselves with the archive of projects of MAN's other students and alumni.

Thereby, we use the successful examples of students' own peers to help them set individual long run goals and learn how to achieve them by means of accomplishing a series of intermediate short run achievements.

As a result, students learn to clearly formulate a task and carry out independent research in various IT areas.

As it was mentioned earlier, many of the projects assigned to MAN students are focused on developing multimedia programs for educational purposes. So an additional benefit is that in the end we obtained a rich collection of software that can be immediately used in classes in middle and high schools.

Successful education in the IT department of MAN includes: development of relatively simple software using MS PowerPoint for education purposes (during the first year), preliminary research work targeted towards development of a more advanced computer program (during the second year), and a completion of individual programming projects and their preparation for publication or distribution (during the third year).

The main principles of providing education in the IT department of MAN are as follows: the level of complexity of individual assignments must correspond to the level of skill and education of a given student, and the topic of the assignment must be strongly correlated with personal, not IT related, interests of a student.

The main components of teaching in the IT department of MAN are:
- lectures, the main goal of which is to familiarize the students with the history of computer sciences, the development of main ideas and methodologies of modern IT;
- student workshops and conferences which help the students of different ages and skills to exchange their ideas and experiences;
- one-on-one meetings between the instructors and the students, designed to provide individually targeted consultations;
- students' individual research work, in order to develop students' abilities to find independently any necessary information using various informational recourses, such as libraries, Internet, etc.;
- development of the original software programs, followed by their description in help-files, advertising brochures, a presentation at the MAN competition, the theses work, a journal article, application to a computer exhibition, etc.;
- public presentation of the individually developed projects at the workshops of the IT department of MAN, as well as various seminars, competitions, and conferences for IT developers and users.

Administrative work if the IT department covers the following areas:
- preparation and publication of articles about the work of the IT department and advertising of the works of its students;
- participations by the instructors, together with the students, in schools, colleges and universities that cooperate with the IT department and where the IT department's students' often get admitted in the future;
- taking part in organization of the Day of Science in various research and teaching institutions and colleges;
- publicizing the achievements of the IT department's students' through various media sources, such as newspapers, TV, internet, magazines, etc.

The experience of the IT department is summarized in the brochure "Theory and Practice of Pre-Professional Development and Education of the Young Programmers of MAN. Analytical and

Bibliographic Review", which can be downloaded at http://www.raspopov.net/MAN/works, http://www.man.gov.ua/publish_more.php?x=8

In addition, the website of MAN of Ukraine (http://www.man.gov.ua/publish_more.php?x=10) provides more detailed information about the interests of the IT department's students, as well as the topics and levels of difficulty of their research projects.

Conclusions

Since 1985, the dominant approach in IT education in Ukraine has been very user-oriented, the main goal of which is to teach every student to use standard applications (MS Word, MS Excel, MS Power Point and Internet) in everyday life. We believe the time has come to balance such a user-oriented approach with a more creative one, based on the international ECDL standards (The European Computer Driving Licence) [11, 12].

Along with the ECDL standards of computer education, the Bolon system of education emphasizes the importance of students' independent development. The experience of MAN, and in particular the approach described in this article, offers an ideal methodology to achieve this goal. The design of multimedia projects, similar to the one described above, helps the students develop their creative skills, teaches them to gather and organize new information, and encourages individual as well as team work.

Development and use of the multimedia computer programs for educational purposes goes a long way towards integrating of school courses and facilitates better quality education of students in colleges and universities.

At the same time, we consider it essential to advance the standard course of "OIVT" (Information Technology and Computer Sciences) taught in 10-11 grades by including in it deeper training in algorithm development and programming, using the successful twenty five years experience of the instructors and organizers of the IT Olympiads and the competitions of young programmers of MAN.

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