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The Approaches to Web-Oriented Education of Computer Science Bachelors in Higher Education Institutions

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The approaches to Web-oriented programming education of computer science bachelors in higher education institutions

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Abstract. The problem of organizing of Web-oriented education of bachelors, and the bachelors of computer science in particular, is relevant for higher education institutions. The IT industry puts forward new requirements for future IT professionals training. This, in its turn, requires the educational process modernization: content specification, updating of forms, methods and means of training to meet the demands of socio-economic development of the society in general and bache-lors of computer science in particular.

The article analyzes and clarifies the notion of Web-oriented education of bachelors, examines modern approaches to the organization of Web-oriented student-programmer education. Several approaches to the organization of Web-oriented bachelor education in higher education institutions are analyzed, such as approaches to the organization of Web-based learning for A La Carte, Station Rotation, Lab Rotation , Individual Rotation, Inverted Learning scenario. Also, the article presents the approach to the technical disciplines Web-oriented education organization, proposed by V.M.Kukharenko and other scientists.

It is noted that the implementation of the approaches to the organization of student Web-oriented education is carried out on international level, in such projects as Erasmus + "Curriculum for Blended Learning" and "Blended learning courses for teacher educators between Asia and Europe".

The article features the results of the survey of NTUU "Igor Sikorsky Kyiv Polytechnic Institute" programming students. The authors propose a new approach to Web-oriented education which combines traditional (30%), dis-tance (50%) and project (20%) learning, using cloud-oriented and WEB-oriented technologies. Project learning structure will include teacher-student collaborative work, teamwork and students project activities.

Keywords: information and communication technologies, WEB-oriented education, approaches to WEB-oriented education, cloud technologies, distance learning inverted learning, online learning

1 Introduction

Ukraine's entry into the Bologna process stimulates the formation of new principles and approaches to the development of higher education. This, in its turn, requires the improvement of forms, methods and tools aimed at creating a coherent system of continuing education.

The requirements for the results of student's studies at universities orientate the teacher to the use of tools that are adequate to the level of development of modern technologies, processing and transmission of information, and, which is equally important, for the needs of students of the new millennium. It is becoming obvious that the tools basis of the educational process in higher education institutions should be made by means and services of ICT and network technologies. The teacher should help students to initiate an internal desire to perceive the world around them with the help of the Internet and those high-tech tools which are able to create conditions for universal access to educational content as well as the latest ICT learning systems in order to make this desire a natural need

In particular, the expected results of the adoption of the Law of Ukraine "On Education" are the creation of a new generation education system that has to provide conditions for education to be received by all categories of the population of Ukraine, an effective system for ensuring comprehensive human development and promoting substantial growth of intellectual, cultural, spiritual and moral potential of the society and personality [14].

Therefore, today we are actively discussing the approaches to the Web-oriented education of bachelors in Ukrainian universities, and, in particular, for future bachelors of computer science training, which requires substantiation of such provisions as motivational, technological, procedural support of the educational process as a holistic pedagogical system that takes into account individual interests, abilities and inclinations and the newest strategies of teaching the 21st century students.

2 First Section

Different aspects of Web-oriented bachelor education in the system of higher education institutions are highlighted in the works of V.Yu. Bykov, S.H, Lytvynova, O. M. Spirina, T.A/Vakalyk, S.O.Semerikov, V. M., Kukharenko, S. M. Berezenska, N. Yu. Oliynyk. Organizational-active, general-didactic, methodological and psychological aspects are considered in their studies.

V.Yu. Bykov [2,3] analyzed a model of organizational systems of open education, the use of which is possible while using WEB-oriented technologies, examined distance learning as a component of Web-oriented learning. In their works, O.M. Spirin and T.A. Vakalyuk [4] consider the main possibilities of using different types of web-oriented

technologies and their analysis in programming training, while scientist S.G. Lytvynova states that cloud-oriented learning environment is a component of Web-oriented learning and emphasizes that synthetic web environment has to be Web-oriented in order to prepare bachelors of computer science as well as to enable students to engage in innovative learning tools [6,7].

S.O. Semyrikov proposes the author's organizational model of combined learning in universities, which involves the use of a learning management system and reflects the current state of development of theory and methodology of using ICT in education [8], V.M. Kukharenko, S.M. Berezenskaya, K.L. Buhaychuk research Web-oriented learning as a combination of of traditional and online learning elements [11,23]. J. V. Trius [21] treats Web-oriented learning as a purposeful process of knowledge acquisition, skills acquiring, with the aim of improving the quality of education. Scientists at the Clayton Christensen Institute consider Web-based learning as a combination of new, disruptive technology [22].

Methods. This article examines such research methods as theoretical sources analysis, studying the advanced experience of foreign and domestic experts in the problem of using IC technologies for teaching students of technical institutions of technical higher education institutions, as well as surveys, questionnaires, modeling,

3 Research Results

Rapid development of information and communication as well as WEB-oriented and cloud-based technologies changes the principles and approaches to teaching programming to future bachelors of computer science in higher education institutions. There accordingly appears a need to rethink and restructure the learning process itself, update the content of the educational program, forms, means and teaching methods. It is both learning technologies and the approaches to the Web-oriented education organization which are changing rapidly and significantly, the education of computer science bachelors in particular.

We understand Web-oriented learning as a system of forms, methods and Web-oriented tools for the formation of professional competences of future bachelors of computer science. One of most advanced and effective technologies is blended learning, which will serve as the basis for the introduction of innovative technologies, and Web-oriented learning in higher education institutions in particular.

The system of Web-oriented education has become widespread in Europe and the United States. Its rapid implementation was facilitated by the development of information and communication technologies, technical (computer) equipping of students, their high level of computer literacy as well as their ubiquitous Internet access.An important contribution to addressing the problem of Web-oriented education was implemented by the Online Learning Consortium, which continues dealing with the challenges associated with the Web-oriented education organization, improving the quality of online learning throughout the world. [18, p.99]

A significant contribution to the dissemination of the latest infrared technologies in higher education has been made through a number of international projects, including

the latest learning strategies The Erasmus + "Curriculum for Blended Learning" project, which involves the following countries: Latvia, Austria, Great Britain is devoted to innovative educational strategies. This project aims at "raising national and European understanding of Web-oriented education, implementing the goal of integrating ICT into the process of learning, combining innovative practices with systematic, scientifically-based strategies for ICT integration" [18, p.100].

Recent studies at the Center for the Digital Education (CDE) show that 90% of the teachers interviewed use creative approaches in teaching subjects using Web-oriented education technologies [19, p.4]. In Ukraine, Web-oriented education technology is only beginning its way.

Various definitions of it can be found in the works of scientists doing their research in the field of educational methodology. In their report on the potential effects and approaches to the Web-oriented education technology implementation the Sloan Consortium defined the means of hybrid or blended education as ones which "integrate online with traditional face-to-face class activities in a planned, pedagogically valuable manner.".They see Web-oriented education itself as an educational approach which "uses online technology to not just supplement, but transform and improve the learning process" [18].

Scientists at Clayton Christensen Institute describe Web-oriented education as "a combination of the new, disruptive technology with the old technology"[22], which "represents a sustaining innovation relative to the old technology"[22], and is actually focused on mechanical blending, i.e. combining old traditional methods of teaching with new ways arising due to the advanced technologies, which appear to be innovative in relation to old technology and, which is most important, do not "offer the old technology in its full form"[22].

Ukrainian experts are now at the start of the Web-oriented education technology implementation as well as its analyzing. Basing on experience and works of their foreign colleagues they are developing approaches to Web-oriented education, methodology and a system of practical recommendations which can be applied in the higher education institutions of Ukraine. Thus, V.M.Kukharenko states that disruptive approaches to bachelors education organization give a new impetus to the development of education, they are more effective, accessible, individualized, and they will over time prevail over traditional approaches to education organizing. He also states that Web-oriented education "as a disruptive technology can not appear on its own". Preconditions for its emergence have to be formed, as well as additional efforts, both from teachers and students part are required during its implementation and development. [23,p.54].

In his work, Yu. V. Trius treats Web-oriented education as "a purposeful process of acquiring knowledge, skills and abilities, as well as mastering the methods of cognitive activity by the subject of learning and developing his creative abilities on the basis of complex and systematic use of traditional, innovative pedagogical technologies and information and communication technologies training on the principles of mutual complementation in order to improve the quality of education." [20, p.304].

Web-oriented learning is an educational concept that combines traditional learning with distance education and online methods which allows students to control the time, place, trajectory, and pace of learning , K.Lisetsky notes [20, p.2].

In particular, Ukrainian scientist V.Yu.Bykov emphasizes that distance learning is a kind of training that is "fundamentally based on the use of information and communication technologies" where "active participants of the learning process perform mainly individualized learning interaction both asynchronous and synchronous in time" [3, p.34].

V. M. Kukharenko , S.M. Berezenska, K. L. Bugaichuk etc., after analyzing works of various authors, specify that Web-oriented education is:

- combination of elements of traditional education and online learning;
- combination of pedagogical theories and technologies;
- educational methodology of teaching and approach that combines traditional methods used in a classroom with computer learning activities;
- the result of integrating online courses with traditional training;
- combination of different technologies into a single integrated learning approach;
- learning program which contains a mix of auditorium and e-learning, a range of formats and media [11, p.49-50].

Nikitina M.S in her work represents approaches to Web-oriented education as a process that involves creating a comfortable educational information environment, a communications system that presents all the necessary training information. In this context, the information environment of a modern university is understood as a combination of traditional and innovative (electronic) forms of learning with the continuous build-up of information and communication technologies (ICTs) and digital resources, as well as constant improvement [15, p.2].

Scientists at Clayton Christensen Institute (the USA), in their definition: " Blended learning involves leveraging the Internet to afford each student a more personalized learning experience, including increased student control over the time, place, path, and/or pace of learning" [15].

They imply that Web-oriented learning has high potential. And it is not only the approaches to the organization, technology selection and ways of learning, the main idea is defined as the personalization of learning [16].

According to foreign experts personalized education involves the following major trends: deep student-centered learning experience, engaging more digital learners, building up higher-order thinking skills, realizing benefits for both teachers and students, blended and iterative approach, productive gamification etc. [22].

All students are different, they perceive information in different ways, at different rates. There is no "correct" way of mastering knowledge. It is the Web-oriented learning and blended learning as the basis of it that aim at helping students, who, in their turn, will be able to receive knowledge both on their own and with a teacher, as well as make a flexible individual training schedule etc.

Web-oriented education appears to be popular and is successfully used in various higher education institutions in Europe, the USA, Asia, Russia, Ukraine both by teachers and students. Ukrainian experts are now at the start of the Web-oriented

education technology implementation as well as its analyzing. Basing on experience and works of their foreign colleagues they are developing approaches to Web-oriented education, methodology and a system of practical recommendations which can be applied in the higher education institutions of Ukraine.

Let's consider the main approaches to the organization of Web-oriented education for students, in particular, the bachelors of computer science in higher education institutions.

The approach to Web-oriented education organization with A La Carte scenario implies doing and learning a teacher's online course aimed at accompanying other kinds of learning. The A La Carte scenario gives the students an option to take an online course with an online teacher and develops a more flexible schedule as well. A La Carte scenario courses can become a perfect option when educational institutions have no learning capacity for students with special needs. It is considered to be one of the most popular Web-oriented education organization approach. [17] . For example, the well-known Coursera platform at Stanford University in the United States which follows this scenario offers a large number of free courses in various disciplines, including programming.

The Prometheus project is a public project for open online courses in Ukraine. The purpose of the project is to provide access to online courses for all people interested in the topic. On this platform, the courses are presented not only by the teachers of the leading Ukrainian higher education institutions, but also by professors from other countries. For example, since 2016, the course "CS50: Fundamentals of Programming", [24] built as a lecture by Harvard University, has been actively used in Ukrainian higher education institutions in the blended learning format. A student or any other person may have access to video collections recorded directly in the auditorium in live communication, to summaries, tasks, additional video materials and workshops from leading experts in the field of computer science. It is worth while saying that in 2015 Yale University refused from their own introductory course of programming for freshmen in favor of using CS50, and this practice continues as long as present days.

The approach to Web-oriented education with Station Rotation scenario is applied for rotating in one classroom or a group of classrooms, where at least one of the stations is connected with online learning. The organization of training in this approach provides that several lessons are held in regular classes (front-end teacher – student work), and after that - students go to a computer class where they individually work on computers or tablets to consolidate knowledge.

The Lab Rotation approach to Web-oriented education contains a lot of points which are similar to the Station Rotation approach. The difference is that the Station Rotation Model implies students moving within the classroom allocated for them. In the Lab Rotation students move to an educational laboratory where they conduct online tutorials [17].

The Individual Rotation scenario to Web-oriented education organization approach enables each student to study with an individualized program mode and individual schedule. Students rotate within their individual schedule developed by the teacher [17]

The approach to Web-oriented education organization following the Flipped Classroom scenario assumes that students, with the help of various gadgets, listen to

and review video tutorials, study additional informational sources individually (in extra-curricular time), after that they discuss new concepts and different ideas in-auditorium, where the teacher helps to apply in practice the knowledge they gained. This is the type studying process organization which encourages students to learn from each other. [9]. Individual exercises, practical tasks and independent work are also performed by students online. In other words, this approach "exchanges" classroom work and homework – at home students do passive learning (i.e. reading and video lecture watching) while in the lecture room they do active learning by discussing the material more deeply.

The issue of Web-oriented student-programmer education is disclosed by scientists in different fields, in particular, an important aspect regarding the peculiarities of this technology in the cloud-oriented learning environment is presented in the works of S.H. Lytvynova. In her research scientist S.H. Lytvynova proves general advantages of the Web-oriented education within the "Flipped Learning" scenario, namely: conditions for active learning are created, a differential approach is implemented, various gadgets and latest technologies are used, the educational process is organized taking into account the needs of each individual student; conditions for team work are created; students develop leadership skills within the curriculum, the process of learning obtains personalized traits, active interaction between the teacher and the student is created, access to educational materials is enlarged; conditions for monitoring the knowledge level with the help of computer technologies are created; parents have the opportunity to participate in the child's educational process.[9, p.235]

While analyzing different aspects of the use of Web-oriented education of future bachelors of computer science in higher education institutions of Ukraine, it is worth dwelling on the Web-oriented education organization for technical disciplines, which was proposed by the scientists working in the team guided by V.M. Kukharenko. This approach is considered as a "methodical system, which is based both on face-to-face learning and on-line technologies (distance learning) and provides a coherent understanding of the content, internal structure, interconnection and interdependence of the elements of the process of teaching technical disciplines". [11, с. 268]

Classical didactic principles were used within the scope of this approach to Web-oriented education: consciousness, visibility, systematic, durability, accessibility, scholarly learning, as well as theory and practice close interconnection.[11, с. 261] The principles of MOOC (Massive Open Online Course) were considered as well as the principles of co-operation pedagogics and social education.

It is worth noting that while using the Web-oriented education, teachers use methodology which includes: forms (individual, group, collective), methods (heuristic conversation, brainstorming, discussion, situational analysis, the method of projects, training quest, etc.), means (laboratory models, virtual simulators, measuring devices, electronic textbooks, etc.);

One of the approaches to the Web-oriented education system implementation in higher education institutions of Ukraine is the use of the Moodle environment (Modular Object-Oriented Dynamic Learning Environment).

The teacher uses the Moodle environment to place educational and methodological material on the discipline in various formats: text, graphics, animation, hypertext etc.

Video tutorials are also placed within the Moodle in order to increase the students' motivation to study the educational material. The Moodle system gives the student access to his resources, which makes it possible to study the discipline. The student independently studies the educational material, performs the necessary training tasks, takes testing procedures in the form of exams, questionnaires, tests as well as gets involved in the forum, e-mail. This allows students to communicate with both groupmates and the teacher and ask questions without having to wait for the lecture. But, as noted by G. A. Cherednichenko, the teacher needs to clearly organize the educational process, stimulate self-control and develop different ways of productive work with students. An important factor is the formation of a stable motivation for educational and cognitive activity, which has to be maintained throughout the whole learning process. [19]

Taking into consideration the positive practical experience of implementing the distance and blended learning technologies by Professor V. M. Kukharenko, studying the Web-oriented training organization approaches in the research of foreign and domestic scientists, we can conclude that in the process of Web-oriented education teachers of higher education institutions should use specific technologies of distance learning and the latest approaches to the organization of educational activities of students. Therefore, Web-oriented education of computer science programming bachelors in higher education institutions should be carried out according to the model of a comprehensive system of Web-based learning, combining traditional (30%), distance (50%) and project (20%) learning, using cloud-oriented and WEB-oriented technologies. The main component of distance learning is seen as extra-curriculum independent work of students. Project learning will include teacher-student collaborative work, teamwork and students project activities (mini-project work). and the use of cloud technologies makes it possible.

Thus, "to properly organize non-auditorium education of computer science students, the following conditions are required: student's motivation for independent work; availability and accessibility of educational and methodological support and reference materials; availability of computer classes; a system of regular quality control of independent studying; counseling teacher assistance.[1,p.5]

It is important to add that Web-oriented education methodology will work efficiently involving the following: [11, с. 270]

- interactive online learning environment;
- high-quality dynamic content (personalization of student's training, the use of adaptive technologies, coordination with national standards);
- analytical capabilities of learning management systems (LMS);
- automatization of the teacher's work;
- students' motivation;

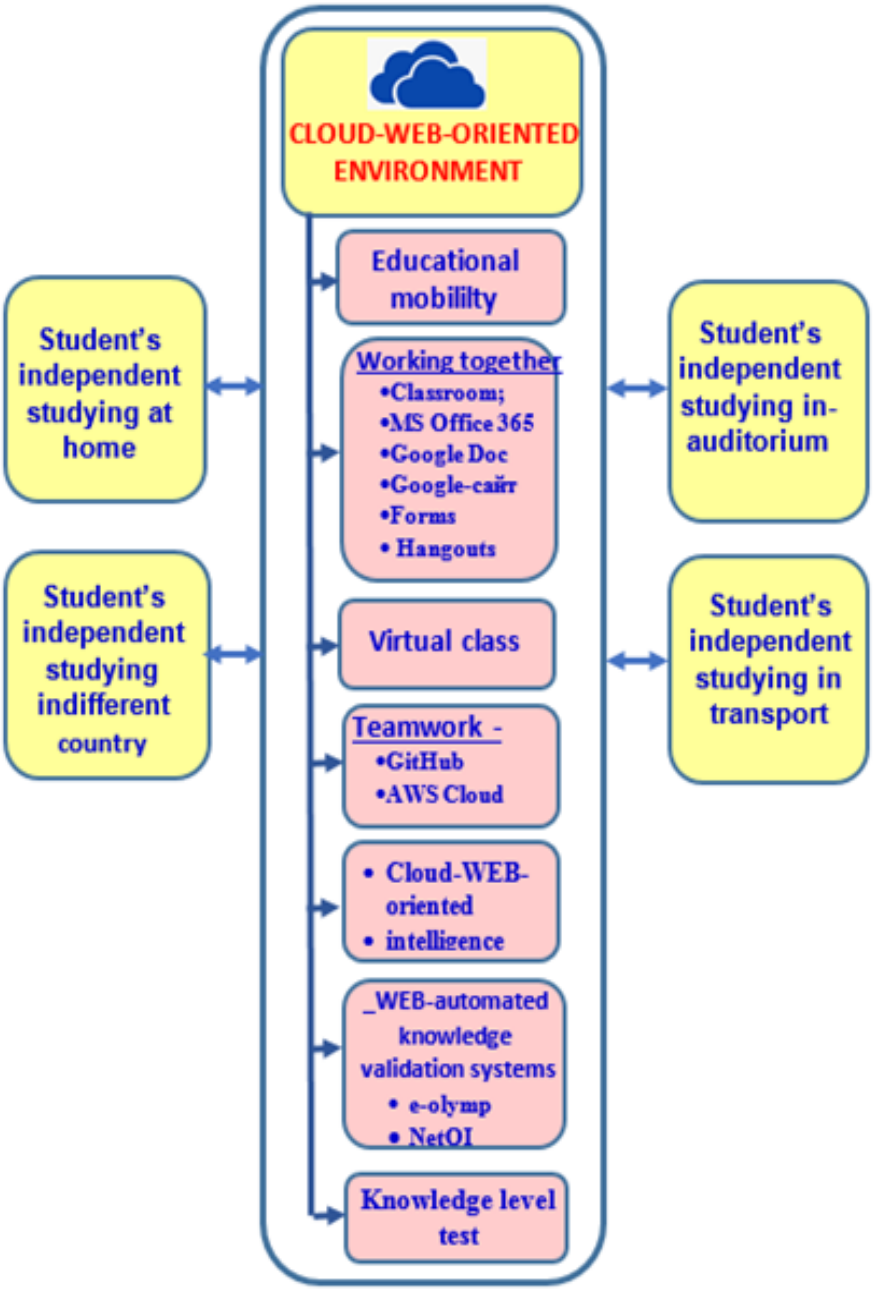

Fig. 1. The system of WEB-oriented programming education of the future bachelors of computer science

In order to form professional programming competencies with student-programmers a Web-oriented programming education system is proposed for future bachelors of computer science (Fig. 1) which primarily consists of cloud-oriented and WEB-oriented environments. As noted by scientist S.H. Lytvynova, the Cloud-Based Learning Environment (CBLE) is understood as a specially created environment, covering all aspects of using cloud computing in organizing the training of students of all categories in different forms and models of learning..[6, p. 9]

Such applications such as MS Office 365, Google Classroom, Google Docs, Google-site, Forms, Hangouts, Google Classroom facilitate student-teacher collaborative work. Students' teamwork is realized through the use of Cloud-WEB-oriented services: compilers (GitHub, AWS Cloud), intelligence maps, automated knowledge testing systems for programming. Knowledge level control has to be accomplished with the help of tests (Office 365 forms or Google Apps).

Important role in student activity organization is played by virtual classes (Skype, Myownconference, Etutorium, Zoom, Cisco etc.). This model is as close to real-time learning online as possible. We understand the virtual class as a special learning environment in which learning takes place in real time, integrating Internet and information-communication technologies and combining the common educational goals and objectives for the student and the teacher [10, p.6]. A student who is absent for any reason can by virtual class means listen to the teacher's lecture in real time and participate in the discussion of the educational material.

The use of the complex approach to Web-oriented education of bachelors will enable students to use the so-called educational mobility. It allows him to take an active part in the learning process while being outside the higher education institution. For example, a student is doing internship in another country, but has the opportunity to attend lectures by means of the virtual class, use the services of the Cloud-WEB-oriented technologies for learning, use educational contents, accomplish home assignments as well as individual tasks, communicate with the teacher etc.Academic mobility is based on an international program which implies that a student of one higher education institution can study in a different higher education institution abroad after concluding a contract.

Thus, within the scope of Web-oriented education organization approaches analysis a survey was conducted among the students of the Technical University " Igor Sikorsky Kyiv Polytechnic Institute" within the analysis of the Web-oriented education of future bachelors of computer science in higher education institutions. 105 respondents took part in the survey. It was conducted to determine the programming students' attitude to the organization of blended learning in their individual preparation to programming disciplines.

The survey results showed that 59 students (56.2%) know the basic principles of Web-oriented education, and 46 students (43.85%) do not obtain all the necessary information about it. It is worth noting that 79 students (84.8%) would like to practice more of Web-oriented education, the basis of which is blended learning. In other words, students study the educational material at home independently via electronic resources, and after that to consolidate and practice the knowledge gained, in the form of a discussion (or laboratory work), under the guidance of the teacher in the auditorium. A

total of 26 students (15.2%) adhere to the traditional approach to learning. The authors' point is that the latter appear to have a lack of sufficient information on the forms, methods and means of Web-oriented education.

Nowadays such apps as MS Office 365, Google Doc, Google-сайт, Hangouts, Google Classroom are not implemented at a sufficiently high level at the departments of the university. Therefore, out of 100 respondents, 42 students (42%) use Excel-Online, 43 students (43%) - Word Online, 34 students (34%) - Google site, 32 students (32%) - PowerPoint Online, 28 students (28%) - Forms OnLine, 16 students (16%) - Google Classroom e.

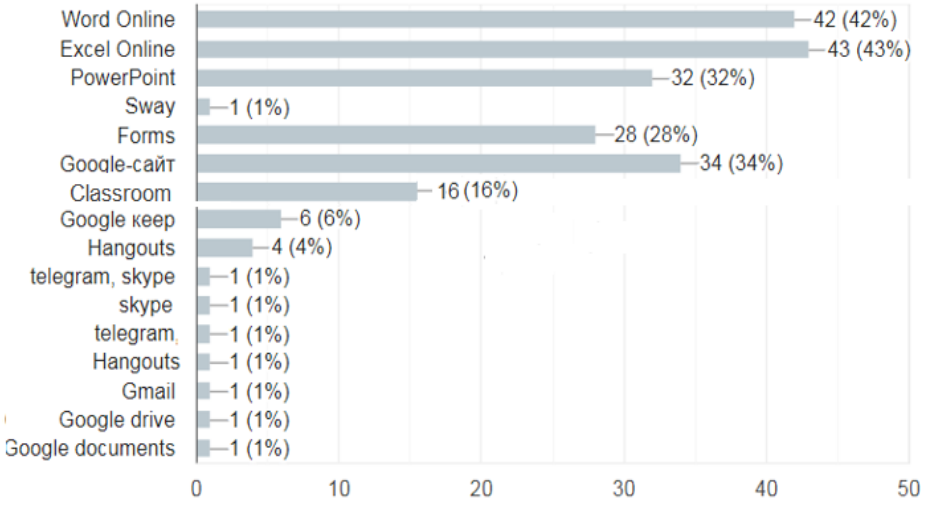

Fig. 2. Using Applications in the Web-Based Training of Computer Science Bachelors

The IT industry activity sphere increases each year, new programming languages appear, new computer science methodologies and technologies are developed, and project management is improved. This, in its turn, increases the amount of educational information for a programming student to master. There is a large number of techniques for processing information today. The use of Web-oriented intelligence cards appears to be the most important. "It is the application of intelligence card method itself that becomes a new tool that provides structuring, systematization, specification and effectively influences student's memorizing information for further use" [13, p.132] This method not only visualizes and organizes large volumes of educational information , but becomes a motivator for further studying as well.

According to respondents' survey results, the use of WEB-oriented and cloud-based intelligence cards in the university departments is low: 11.8% of students apply them in educational activities, and 88.8% do not pay sufficient attention to these services. A

similar survey among programming students was conducted in 2018, its results showed that "in the educational process of programming languages teaching in higher education institutions such web-based technologies as compilers, automated programming verification systems, intelligent maps are not applied in the full capacity" [12 , p.84].

After comparing the results of 2018 and 2019 surveys, the authors conclude that the use of WEB-oriented intelligence cards within the independent study of teaching materials in the discipline of programming grew by only 1.8%, which actually means it didn't change. The polling rate of respondents in the 2019 survey makes 11.8% [12, p.84] compared with 10% of the 2018 poll.

Respondents' survey results showed that future bachelors of computer science should pay more attention to the use of WEB-oriented and cloud-based automated testing systems for programming tasks in preparation for practical lessons in the course of programming. The statistics on the use of these systems is presented in Fig. 3 and it demonstrates that out of 112 respondents, 69.9% do not use any of the systems presented in the programming tutorials, 26.8% - use e-olymp, etc.

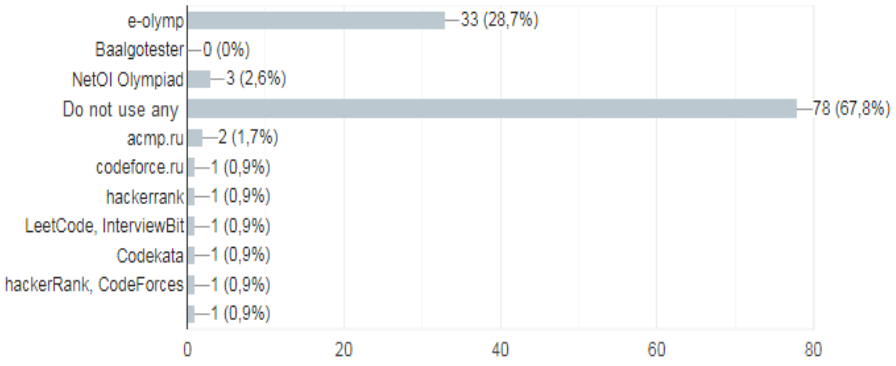

Fig. 3. Use of WEB-oriented automated systems for testing programming tasks in the course of WEB-oriented computer science bachelor's training

One of the peculiarities in the learning process of future bachelors of computer science is the point of studying several programming languages. Therefore, it is important for comprehensive development in programming that students-programmers get acquainted with different types of compilers, such as WEB-targeting and cloud compilers, starting from their first year of studying. This will enable them to program from any location, at any time and thereby accelerate the process of programming learning.

Figure 4 shows the rate on the use of WEB-oriented compilers within the students' independent work on practical programming tasks, namely: Codepad.org (4.1%), ideone.com (4.1%), Cppshell (1%), jsFiddle (2%), WandBox (2%), Tutorials Point (1%), Different (2%), Do not use any WEB-oriented compiler (86.5%)

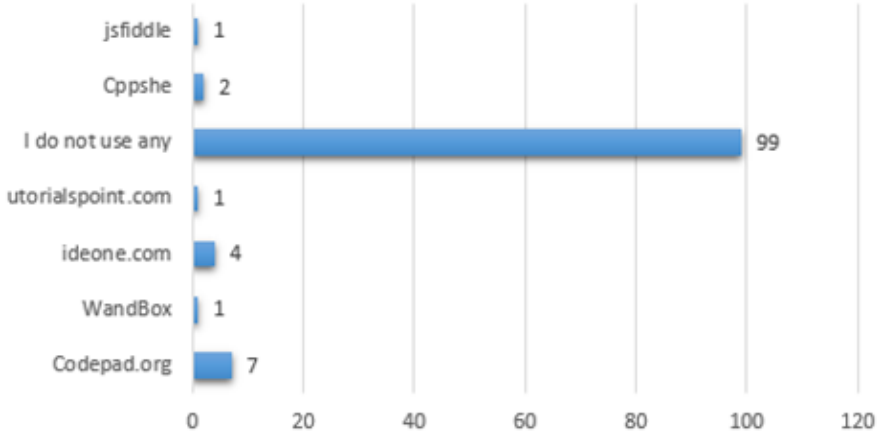

Fig. 4. Using WEB Oriented Compilers in the WEB Oriented Bachelor of Computer Science education

Analyzing the results of NTUU "Kiev Polytechnic Institute Igor Sikorsky" student-programmers survey the authors came to the conclusion that cloud-oriented and WEB-oriented applications in team and project activities of students, as well as in the teacher-student collaborative work are not used to a sufficient level while educating future bachelors of computer science.

4 CONCLUSIONS

After analyzing the experience of applying Web-oriented education approaches in different countries, we conclude that both in Ukrainian universities and abroad – various approaches to bachelor educating (and computer science bachelors in particular) in higher education institutions are used quite actively. The difference lies in national traditions as well as the approaches to the content of education itself

It is noted that Web-oriented education organization implementation is applied internationally, in such well-known platforms as Coursera (USA), Prometheus (Ukraine), international projects like Erasmus +, “Curriculum for Blended Learning” and “Blended learning courses for teacher educators between Asia and Europe”. However, it is not applied in the system of higher education institutions widely.

The article considers approaches to Web-oriented education organization, in particular, blended learning of future bachelors of computer science in higher education institutions of Ukraine, such as flipped learning approaches, La Carte , individual rotation, the use of Moodle, which are popular among higher education institutions in Ukraine, Europe, the USA, Asia and Russia, and are actively used both by university lecturers and their students.

Taking into consideration the positive practical experience of implementing the distance and blended learning technologies by Professor V. M. Kukharenko, studying

the Web-oriented training organization approaches in the research of foreign and domestic scientists, as well as analyzing the results of the student-programmers survey, the authors emphasize that it is advisable to use the WEB-oriented programming teaching system for educating future bachelors of computer science, which offers 20% of project training, 30% of traditional and 50% of distance learning. The structure of the project training includes: student-teacher cooperation, teamwork and groupwork as well as individual project activities of students.

Some of the disadvantages of blended learning include the fact that teachers need to devote a lot of time for preparing interesting and understandable teaching materials (video lectures, methodological guidelines for carrying out practical work, etc.). It is also very important for the strategy of Web-oriented learning to be supported by the administration of higher education institutions.

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