The technique of the use of Virtual Learning Environment in the process of organizing the future teachers' terminological work by specialty

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Abstract. This paper studies the concept related to E-learning and the Virtual Learning Environment (VLE) and their role in organizing future teachers' terminological work by specialty. It is shown the creation and use of the VLE is a promising approach in qualitative restructuring of future specialists' vocation training, a suitable complement rather than a complete replacement of traditional learning. The concept of VLE has been disclosed; its structure has been presented as a set of components, such as: the Data-based component, the Communication-based, the Management-and-Guiding ones, and the virtual environments. Some VLE's potential contributions to the organization of terminological work of future biology teachers' throughout a traditional classroom teaching, an independent work, and during the field practices has been considered. The content of professionally oriented e-courses "Botany with Basis of Geobotany" and "Latin. Botany Terminology" has been revealed; the ways of working with online definer (guide), with UkrBIN National Biodiversity Information Network, with mobile apps for determining the plant species, with digital virtual herbarium, with free software have been shown. The content of students' activity in virtual biological laboratories and during virtual tours into natural environment has been demonstrated. The explanations about the potential of biological societies in social networks in view of students' terminology work have been given. According to the results of empirical research, the expediency of using VLEs in the study of professional terminology by future biology teachers has been confirmed.

Keywords: Virtual Learning Environment; E-learning; terminology competence, system of future science teachers' vocation preparation.

1 Introduction

The integration information and computer technologies (ICT) into the educational process sets up higher requirements for the future teacher's professional qualities. Thus,

an updating the approaches to the organization of educational activities in higher school with an emphasis on self-development and self-study ones become more and more vital.

The intensity of the educational process increases, it also becomes more dynamic and continuous (we mean the principle of lifelong learning), and educational technologies are changing accordingly. Electronic learning (e-learning) emerges as innovative educational technology [2]. Ukrainian higher educational institutions (HEI) are actively implementing these technologies into the educational process. The integration of Ukraine toward European and world educational spaces challenges both pedagogics science and education system to search for effective approaches to quality-based restructuring of future specialists' vocation preparation. One of such aspects is the creation and use of the Virtual Learning Environment (VLE) which is a complement rather than a complete replacement of traditional classroom training.

At present, there are many tools for creating web-based learning experiences [30; 41] that becoming more powerful and easier to use, and Internet technologies advance at unexpected levels.

An important the feature teacher's occupational formation is the development of professional-and-terminological competencies being revealed by way of understanding of biological concepts and using discipline-related terminology. For that reason, innovative educational approaches that aimed at professional competence formation and based on future teacher's terminological competences become increasingly popular.

However, due to the fact permanent updating of e-learning concepts, it is necessary to develop new approaches to organizing the future biology teachers' terminological work by specialty into VLE that are professional significant to them.

This research *is aimed* at identification opportunities and a specificity use of E-learning and Virtual Learning Environment in organizing future teachers' terminological work by specialty.

2 Materials and methods

Issues related to professional-and-terminological competence formation have been investigated by scientists in various aspects. Especially, the communication competences were considered in the studies by Mikhail M. Bakhtin [3], forming of professional-and-terminological competence of future bachelors in economic area of expertize were highlighted by Iryna V. Vlasiuk [66]; Lesya V. Viktorova [62] proposed a method to perceive the veterinary terminology originating from Latin and Greek. These and others researches contributed a lot to the evolution of knowledge about professional-and-terminological competence formation.

Scientists are united in their viewpoint about fact that the terminological language fluency by the future science teachers is the key to their successful professional activity. Thanks to this fact they can selection of terms in accordance with the academic topic, distinguish of terms semantic as well as their Latin counterparts, use ones of according to their definition, terms and professional words differentiation.

Thus, the biology teachers' vocation preparation must involve the formation

students' terminological competence by high level. And since biological terms are predominantly of Latin origin so it is quite important to understand their semantic meaning. It is the modern ICTs that greatly simplify process mastering of terminological competences.

Recently, scientific literature pays much attention to increasing the efficiency of the educational process with the use of ICT. The theory and practice of higher education have accumulated experience that can form the basis for students' training system upgrading with the help of ICT: the didactic principles and regularities of educational process informatization in higher education are determined by Olga V. Bondarenko [7], Valerii Yu. Bykov [8], Maiia V. Marienko [28], Serhiy O. Semerikov [49], Vladyslav Ye. Velychko [13], Myroslav I. Zhaldak [70] etc.; the peculiarities of ICT application in high school educational process are studied by Galyna O. Kozlakova [9], Olena O. Lavrentieva [23], Natalya V. Rashevska [44], Irena V. Robert [46], Lina M. Rybalko [24], Snizhana O. Zelinska [69] etc.; the computer-based learning tools are theoretically substantiated and developed by Oksana M. Markova [27], Serhiy A. Rakov [43], Kateryna I. Slovak [31], Vladimir N. Soloviev [34], Andrii M. Striuk [45], Tetiana A. Vakaliuk [60], Nataliia P. Volkova [42] etc.

We can observe a significant increase in the number of studies that have focused on ICT use in the educational process. In particular, these are the studies of Svitlana M. Amelina [57], Dmytro S. Antoniuk [61], Liudmyla I. Bilousova [6], Halyna I. Ivanova [18], Vasyl P. Oleksiuk [35], Liubov F. Panchenko [36], Olga P. Pinchuk [39], Volodymyr V. Proshkin [17], Ivan M. Tsidylo [54], Yurii V. Tryus [51] and others. In their work Nadiia R. Balyk [4], Dan Benta [5], Pierre Dillenbourg [10], Evgen O. Kozlovsky [20], Hennadiy M. Kravtsov [21], Oksana S. Lytvyn [50], Pavlo P. Nechypurenko [33], Kateryna P. Osadcha [56], Noawanit Songkram [53], Simhachalam Thamarana [58] are paid special attention to VLE.

3 Theoretical background

For the past few years, computer technologies for the support teaching have been developed including as assessment or communication tools. It is well known the modern technologies enable to be combined these tools into single products that called VLE. So, a VLE can be defined as a self-contained computer based online environment enabling interactions between instructor and learner [58].

A VLE handles information that directly related to students' study, for instance, they are lecture notes, online discussions and perhaps students' grades. Moreover, a VLE deals with the management of other information which can be directly not connected with teaching "in the classroom" [58].

According to Simhachalam Thamarana, a VLE is an online (web) environment where various tools are provided for teacher and student to facilitate the learning experience. VLEs generally operate across the World Wide Web, so one often only need an Internet connection to access a VLE. But even so the teacher has a chance to give access for only registered students.

VLEs can be identified by the following main features, namely [10]:

- A VLE is a designed information space.
- A VLE is a social space since educational interactions occur in the environment turning spaces into workplaces.
- A VLE is explicitly represented; this information / social space representation can vary from text to 3D immersive worlds.
- Students are not only active participants but they also actors. They co-construct the virtual space. In light of this viewpoint VLEs aren't restricted to distance education, they also enrich classroom activities.
- The VLEs integrate heterogeneous technologies and multiple pedagogical approaches.
- Most virtual environments overlap with physical ones.

Let's examine the advantages of using a VLE. The VLEs are used to support teaching and learning. They have potential in order to foster learning just like in a face-to-face teaching. We mean following things: information delivery; peer support; organizing a group work; self-assessment; formative / summative assessment; teacher-student communication; tutorials, and whatever. The fact that VLEs provide a range of tools to secure the same teaching and learning principles like traditional classroom are established. At the same time these tools are delivered online in a virtual environment [53].

Blended Learning is an educational concept envisaging knowledge acquiring by learning individual both on-line and under teacher's supervision. This approach makes it possible to monitor time, pace and focus of study material, the integration of traditional methods and modern technologies. This model does not foresee complete abandonment of traditional education (B&M Education), since face-to-face education involves the formation and improvement of linguistic and socio-cultural skills. So Blended Learning is a mix of traditional B&M Education and E-learning.

VLEs aren't restricted to distance education [58]. It can be applied in course of traditional classroom (Brick and Mortar Education) as well as in Blended Learning (on authors' opinion [48]). Internet-based activities are generally added to enrich a presential of study ones. This process can be just an add-on (for instance, the teacher points to extra resources that the students should study by means VLEs) or have a stronger influence on the teacher's pedagogical approaches. E.g., technology can become the enabling factor for functioning complex socio-constructivist study scenarios [48].

Consider the possible options for the forming and development of future biology teachers' professional-and-terminological competence via the VLE.

4 The Virtual Learning Environments tools overview

For deliver certain types of information the modern IT services, such as mobile applications, cloud repositories, media hosting, social networks, are being used to. It should be noted that in the educational process, regardless of growing IT technologies relevance, the essential role belongs to the face-to-face teacher-and-student interaction. It is well known young people are familiar chiefly with gaming computers and mobile

applications and use the technical devices mainly for entertainment purposes. In such a way there is a threat of the simplified perception of VLE-based educational technologies by young people. In this case it is teacher that contribute to the students' learning motivation creating and IT application promotion with widen the conditional framework of the educational environment and even provided an exit its bounds.

The active use of VLE technologies is intended not to substitute but to supplement the educational environment.

Let's review basic VLE tools that can be used in blended learning during the future biology teachers' vocational training process (see Fig. 1) in light of forming the professional-and-terminological competences.

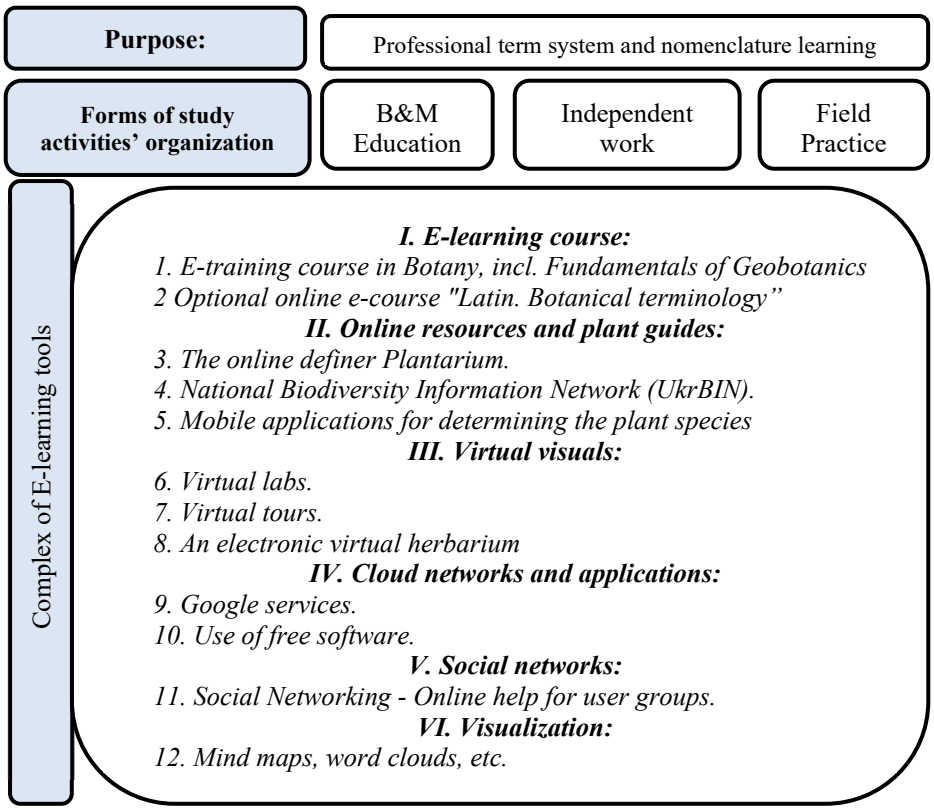


Fig. 1. Complex of E-learning tools used in the organization of students' self-studying process within learning professional biological and binary terms

The VLE structure can be represented by the following components:

- the Data-based component (HEI's website, e-textbooks, e-learning courses in LMS Moodle or other LMS);
- the Communication-based component (ensuring video conferences, webinars, chats, forums, e-mail, social networks);

- the management-and-guiding component (organization of individual or group work, current and final students' knowledge assessment, educational process monitoring),
- the virtual environments (laboratories, tours, electronic collections - herbariums, encyclopedias, etc.).

In our previous researches we have analyzed the properties and capabilities of a number of VLEs and tools applications in course of future biology teachers' terminological and classification education [25]. We advisable to use them both in course of lecturing and conducting laboratory-practical classes as well as during students' self-study process.

4.1 Survey of e-training courses for organizing future teachers' terminology work

The efficiency of future specialist's vocation preparation is greatly fostered thanks the use of online training courses making the educational process more individual.

Below the concept of several electronic courses designed to form the professional-and-terminological competences of future biology teachers will be introduced.

The courses are formed according to the well-known principles that underlie the organization of distance learning in synchronous and asynchronous modes. On top of all the specific character of the academic natural-science subjects embracing the need for microscopic, laboratory experiments and observations, the study of natural samples and fixed preparations, excursions into nature, and whatever, is also takes into account.

Such courses can be distributed on a variety of media, as well as on educational sites on the Internet, as well as sites when e-learning management systems LMS Moodle are installed. E-training course can be extended via variety of information carriers and published on educational sites in the Internet, including distant learning technology like MOOC. Online courses for the implementation of synchronous learning involve the use of teacher-student interaction tools in real time (chat, virtual class, general and special purpose browser environments, etc.).

E-learning management system of Kryvyi Rih State Pedagogical University (KSPU) is represented with LMS Moodle platform [29]. There is a spreading experience of introducing lecturers' personal educational sites where students' independent study activities are organized with use the blended learning technology. Blended learning resources presume shared use of both traditional and e-learning practices and tools. In this case the part of e-learning technologies in educational process can range from 30% to 80%. Currently in KSPU both fundamental academic courses of natural-science preparation and subject-science courses are being developed.

The main purpose of the e-learning course *"Botany with Basis of Geobotany"* is to teach future biology teachers to determinately and appropriately use biological terms, to construct new ones independently, including taxon names. The course contains information on the history of biological terminology and classification formation, the etymology of plant names, the specifics of plant groups' taxa word formation, as well as the meaning of word-building basic elements. Creating this course, we taken into account some general pedagogical regularity. It is considered the terminoelements recognition in definite cases determines the efficiency of professional terminology

interpretation and memorization by future biology teachers and their proper practical usage in vocational communication process.

The optional e-learning online course "*Latin. Botany Terminology*" is destined to expand students' knowledge in the field of biological terminology, to identify terminological Latin-Ukrainian correspondences, to promote the formation of future teachers' professional terminology system.

Indeed, the Latin language course is not included both in the normative and variable parts of the specialty-based developed curriculum 014.05 Secondary education (Biology and human health) specialty. Therefore, this special course is optional; it is developed for first year students (1-2 semesters) of the Natural Sciences Faculty of KSPU. One of its major tasks is a preparation student for understanding the academic subjects as well as international scientific terminology and biological classification principles based on Latin terminology knowledge.

The "Latin. Botany Terminology" course is aimed at: preparing students to read Latin texts with the help of the dictionary; digesting of international Latin biological terminology; mastering of Greek-Latin terms elements semantic analysis methodology; compilation of an individual biological vocabulary; processing of general principles of floristic and physiognomic naming of various plant groups; working of binary biological classification rules.

The purpose of course "Latin. Botany Terminology" is to teach students elementary grammar (phonetics and morphology), a certain vocabulary that underlies inter-national terminology in the field of biology; to develop skills of elemental analyze of Greek-Latin-based terms and ability to read dedicated biological texts and phytonyms; to show methods how to work with Latin educational and supplementary literature; how to apply professional biological terminology in practice, and what's more, to improve students' linguistic culture and do wider their outlook.

The optional course "Latin. Botany Terminology" has been published in e-learning courses management system LMS Moodle of KSPU. This system is focused, first of all, on the arrangement teacher-student interaction under the conditions of self-timed online learning, and can also be effectively used to arrange both face-to-face and correspondence study as well as online learning [22].

4.2 Use of the online definer (guide) in the future biology teachers' practical vocational preparation

The main purpose the field practice by botany is an evolution students' ability to use the definer on thesis-antithesis principle. As generally accepted, that is quite tedious and time-consuming work. In such case the online resources and mobile applications have been proven themselves as quite helpful tools in terms of time optimization, students' cognitive activity intensification and motivation.

The *Plantarium* [40] is a non-profitable project; it's an atlas of species and an illustrated online plant identifier meaning for a wide range of users (amateur and botany professionals, geobotanists and environmentalists) (see Fig. 2).

The main purpose of this project is to help concerned persons with identification of wild plants and lichens into the Post-Soviet space. Last but not least this project is also

aimed at collection of comprehensive photo gallery of all plant species. The indisputable advantage of the Plantarium plant determinant, in contrast the conventional plant determinant that based soft or hard copy, is the possibility to select an arbitrary number of key features of investigating object. That is, app does not use the dichotomous thesis-antithesis key. The search results in the app database generate a set of species that match the query. Researchers of different professional levels via Plantarium tools can easily identify a particular plant specimen by means of a photo.

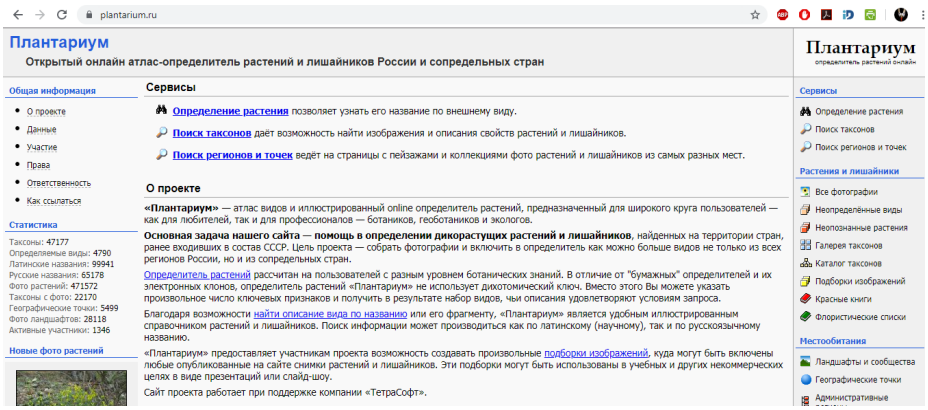


Fig. 2. Online plant identification guide “Plantarium”

In general the advantages of this resource are as follows: accessibility and usability; availability of an illustrative guide; possibility to search by key attributes; relevance of use during the laboratory-practical course in “Botany with Basis of Geobotany” and relevant educational vocation practice; a chance to create random sets of images (slideshows) for educational purposes.

However, we want to take emphasize the disadvantages this app. This is, in first, the high error probability identification of plant due to the specific features of the anatomical and morphological its structure levelling which can’t be recognized by the photo. Such studies require examination of the specimen under a binocular microscope. But even so, the use of Plantarium tools allows considerably intensify the students’ terminology work, rids of them routine retrieval of the information.

4.3 UkrBIN – National Biodiversity Information Network as an informational support

On Fig. 3 you can see screenshot one of pages an online search database Ukrainian Biodiversity Information Network [59] that use for study biological links between animals, plants and fungi (forage plant phytophagus, parasite host, and whatever).

The distinctive feature of this resource is considered the digital material has represented by a photobase of living objects (plants, animals, fungi) in a natural or anthropogenically transformed environment [40].

The material posted on the UkrBIN resource can be used to organize terminological

work of future biology teachers, to improve the level of their terminological competence. Last but not least, providing relevant territorial information the UkrBIN resource helps to improve the quality of students' research work.

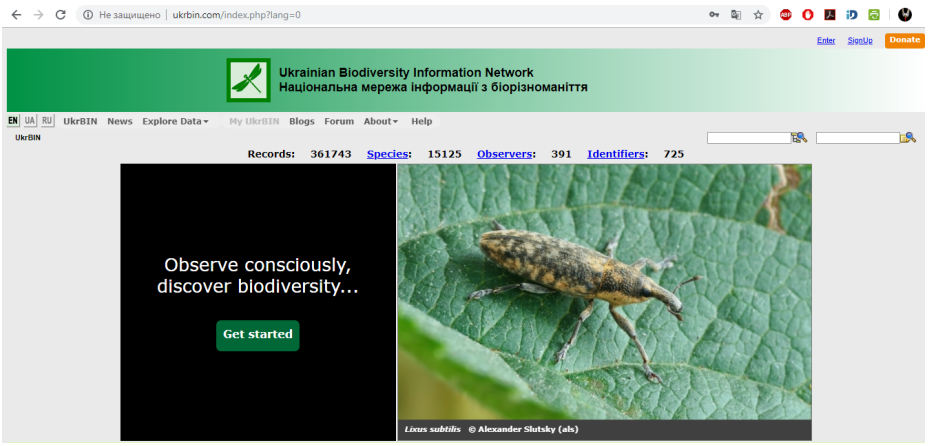


Fig. 3. The Ukrainian Biodiversity Information Network

4.4 Virtual labs in VLE

Should take into account a *virtual lab* is a VLE allowing the simulation of real-world objects in a computer among and helping students to gain new knowledge and skills. Such laboratory can serve as the mechanism for various natural phenomena studying with the possibility of their model's development [32].

Let's make review some virtual biological labs which we could capably introduced into future biology teachers' vocational training. Having analyzed free virtual labs on natural sciences disciplines we can state the predominance of English-language databases while accessibility of Russian-speaking and Ukrainian-speaking virtual labs is by far fewer.

Virtual Biology Lab [63] is a free online educational resource that simulates the natural environment considering living world feedback to changing conditions. The resource also contains interactive guides for study ecology, evolution and cell biology.

The *Online Education Program* [19] is designed to simulate a lab with the possibility to make one's own adjustments. So as to facilitate the organization of the research process in this environment the consistent guidance has been developed for users.

Connect Virtual Labs [67] is a kit of biological laboratories that students can access whenever and wherever.

LabBench Activities by Pearson is an interactive, free-access virtual biology lab [37].

VirtuLab [65] is Russian-language stand-alone that don't need any installation and has free platform. This is a project that can use for development of virtual laboratory works in physics, chemistry, biology, ecology.

The Global School Lab International Project is a portfolio of projects and researches, shaped as of pre-made templates. Virtual education laboratory (laboratory

work) in biological courses includes: VirtuLab 6-7 (“Botany. Zoology”); VirtuLab 8 (“Human being and his health”), VirtuLab 9 (“General Biology, Grade 9”), VirtuLab 10-11 (“General Biology, Grades 10-11”), VirtuLab (“Ecology”) (it shows on fig. 4).

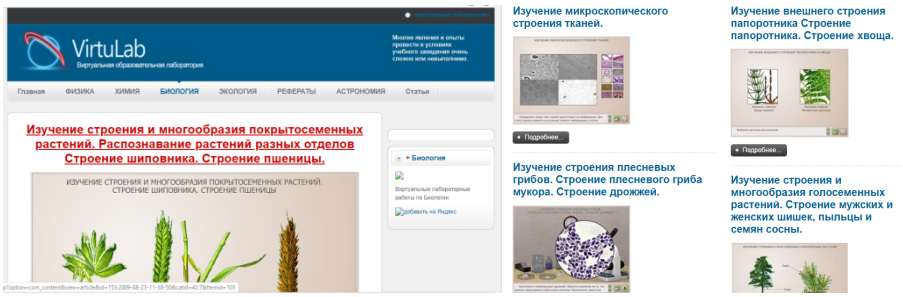


Fig. 4. Virtual laboratory (VirtuLab)

Biology with Olga [64] is a resource containing a video library, online tours, virtual labs, and notes about interesting biology. The virtual labs are introduced here in accordance with biology training courses for pupils by 6-11 grades.

SMIT Ukrainian-language Virtual Laboratory [52] is a series of pedagogical software or electronic textbooks that have received the Stamp of the Ministry of Education and Science of Ukraine. They are designed for schools and vocational education institutions and use multimedia technologies (animations, videos, sound) for showing of natural effects. The developer works on a series of professional tools for higher education. Unfortunately, now it is a paid business product.

Far and away the opportunities of virtual labs usage are quite wide. They can be use by teacher demonstrating experiments at a stage of study new information, while working out the methodologies of both chemical and biological researches based on virtual objects, by individually or in problem groups. Such tools are expedient during arranging individual search activities students on the all stages – from educational content securing to its digestion monitoring.

Thus, the use of virtual laboratory work as referred to the real ones can be of demonstrative, generalizing and experimental kind.

The main advantages of virtual laboratories (VLs) are:

1. Efficiency – time and resource saving. No need to buy expensive equipment and reagents. Furthermore, obsolete equipment, ware, reagents can distort the experiment outcomes and serve as a potential source of danger for people, involved in the educational process. The high cost of acquiring computer hardware and software is offset by their versatility of [15].
2. VLs be up ability to simulate processes that can’t occur under laboratory conditions and visualize them on a computer screen. Modern computer technologies allow to explore processes that difficult to observe in the real environment without use of additional equipment. They may be, for example, objects of the small size (microscopy) or groups of large size (populations, biomes, etc.).
3. By means of VLs everybody has ability to observe and investigate on a different

time scale processes occurring in fractions of a second (e.g., cell division) or, conversely, lasting for several years (succession, population fluctuations) [20].
4. Work into VLs is safety throughout using volatile and poisonous substances, alkalis and acids, electrical appliances, and whatever [24].
5. It is controllability and repeatability of experimental conditions. In this case we have in mind providing a series of experiments with different values of the set-up parameters, in the end - obtaining the expected and reliable outcome [68].
6. Perspective use in online learning, blended and brick and mortar ones or students' self-education process when there is no opportunity to work in real laboratories [20].

Over and above, VL is an example of an artificial learning environment that allows observation and detection of cause and effect links between of real-world objects with use computer models. VLs is essential when you study the microscopic anatomical structure of plant and animal organisms at the cellular and tissue levels, which is not always possible to do in real laboratory conditions for a number of reasons.

But the potential of VLs is not limited to the above-mentioned features, they are also quite relevant during investigation the living organisms, both at the organismal level (animal and plant morphology) and at the above-organismal one (trophic chains and interspecific interactions of organisms, the structure and functioning of populations, biocenoses, and biosphere in general).

4.5 A digital virtual herbarium

An electronic virtual herbarium is an information resource that provides fast and high-quality access to renewable and open databases, a higher level of accumulation, storage and dissemination of text and graphical biology information in contrast with usual herbarium. Taking into account the training of future biology teachers involves the formation of a knowledge system on the composition and functioning of flora and fauna, there is a need to expand opportunities for the use of biological collections and to transform herbarium funds into a virtual electronic format.

Advantages of digital herbarium are prevention of unique samples damage, economy, ergonomics, availability, and renewability of data. The development of modern technologies and computerization are being enabled exchange of huge scientific information through wide access to specialized databases [1; 63], including the herbarium collections (Fig. 5).

It was *IBD* [1] that became such an online directory for botanists. It is organized in the form of indexes and allows using the online version of available botanical information. This project was implemented by a team of herbarium composition specialists from Harvard University (Cambridge, the USA), Missouri Botanical Garden (St. Louis, the USA), a group of Canadian programmers, the Botanical Department of the Museum of Natural History and the University of Helsinki (Finland).

Computerization of the National Herbarium (*KW*) [16] database of the Botany Institute named after M.G. Kholodny (Kyiv, Ukraine) envisages the development of a software block that will be able to process information about species, covering all related search data displaying, namely: family name, species list, species status,

distribution data, year and collector [1].

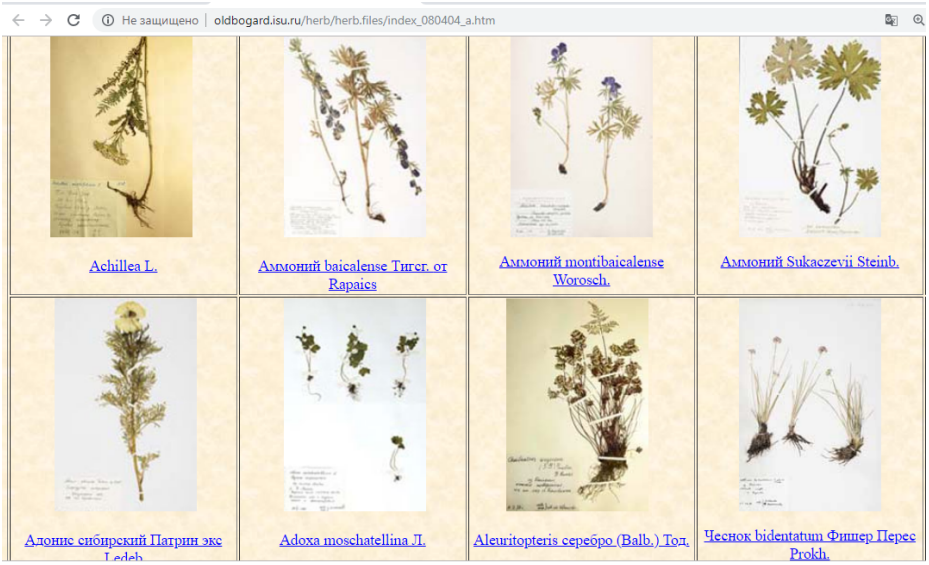


Fig. 5. Digital (virtual) Herbarium [26]

Definitely virtual herbarium has some disadvantage. It should be carrying to them follows:

- the possibility of biology specimen diagnostic features loss (which, for example, is visible only under a binocular microscope) and impossibility of sampling for other analysis making purposes like genetic, biochemical, etc.;
- the limitation herbarium's database by server capacity;
- the need for costly equipment and labor to digitize large amounts of herbarium funds.

But even so, if necessary, it always possible to address directly to digital herbarium specimens to redefinition, to do morphometric measurements or genetic analysis of plants, to make sampling for spectrometry.

5 Organization of future science teachers' terminological work among Virtual Learning Environments

5.1 Implementation mobile apps to definite the biology terms

There are a number of mobile apps gaining popularity among both lecturers and students can be useful for the biology teacher in organizing pupils' research activities. In particular, these are apps for identifying living objects in the wild environments by photo. They have a number of advantages including accessibility, simplicitability (even at an intuitive level), adaptability to different gadgets and operating systems, in the end

they usually free of charge, have visibly attractive and smart interface.

All of the above things provide an increasing relevance of the mobile apps usage as a state-of-the-art modern supplementary to the traditional educational system. The mobile app is software developed for use on smartphones, tablets and other mobile devices [71]. It is well known the basic set-ups of mobile apps are provided and pre-installed on the device and can be downloaded from the online application stores like AppStore, Google Play and others, both free and for payment [11].

The apps' type that we investigate are introduced by a large group working on the principle of researched vegetative and generative organs plants by means of photo verification with a photo base. But some apps even offer the opportunity to consult with specialist or experts. Definitely, a using such kind of apps is relevant to realization the route's method of vegetation research during a botany field practice.

The mobile application system using in the vocational training process by specialty 014.05 Secondary education (Biology and human health) is represented by 5 main functional groups (see Fig. 6).

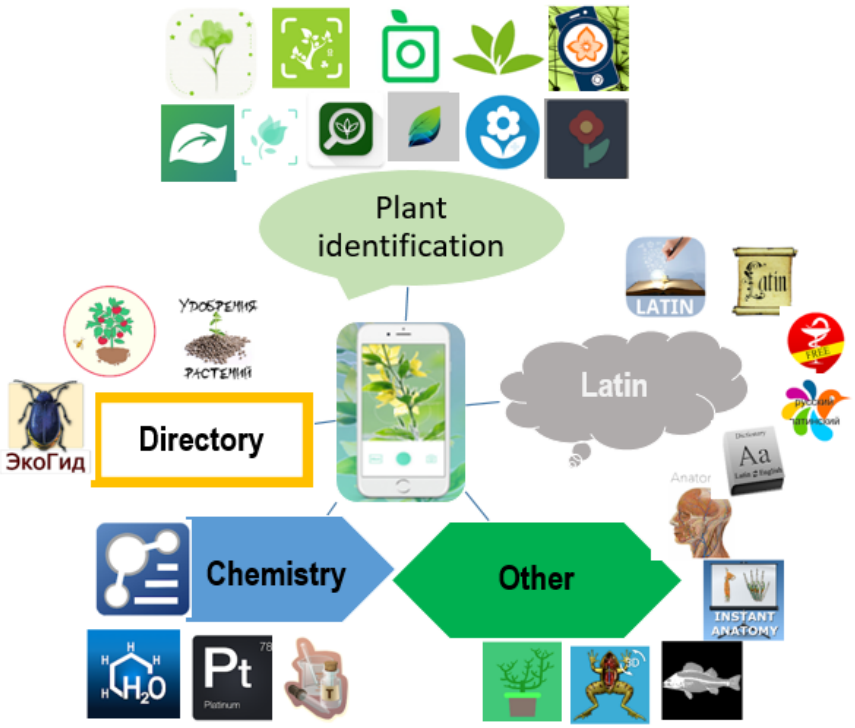


Fig. 6. Mobile apps for the future biology teachers' vocational training (based by [40]).

There are a 5 number of main type apps for these purposes.

1. Mobile apps using to determine the plants species.

2. Reference mobile software that can be helpful to conduct the morphological description of plants, to identify the features of their chemical composition and use in medicine, to realize of agricultural activities (crop, gardening, horticulture, etc.). Their use is justified in teaching such subjects as “Basis of Agriculture”, “Medicinal plants”, “Basis of Ecology” to study the morphology and bionomics of plants, their practical application in phytotherapy.
3. The mobile apps that efficient in mastering the biological terms of Latin origin. They can be also useful for study disciplines of vocational training process like “Botany with Basis of Geobotany”, “Zoology of invertebrates and vertebrates”, “Microbiology and Virology”, “Bases of Ecology” and “Human Anatomy”.
4. Special mobile apps helping to demonstrate certain features of biological systems’ structure or functioning.
5. Mobile apps in chemistry that can be useful in the studying and fastening of students’ knowledge about the cells’ chemical composition, metabolic process-es of aerobes and anaerobes, as well as in mastering the subjects of vocation training the future biology teachers like “Plant Physiology”, “Human Anatomy”, “Botany with Basis of Geobotany”, “Zoology”, “Microbiology and Virology” and others.

Significant advantages of mobile apps are follows: accessibility, cost-efficiency, usability, time saving kind. However, these facts should clarify. Unfortunately, such software tools do not always provide accuracy in the terminological definitions and require clarification of the studied living organism belonging by means of identification’s key. In general they are useful in determining the affiliation of an object to taxa of super-species rank (species, genus) [38].

Mobile apps for plant identification are of practical importance and can be used in the laboratory course like “Botany with Basis of Geobotany”, “Introduction to the Specialty”, “Phytodesign”, “Medicinal Plants” and other vocation oriented study subjects; in course of nature tours; while fulfilling by students individual research and qualification studies tasks, in self-educational process [38].

5.2 The virtual tours into natural environment

Virtual tour is one of the types of educational process arrangement in HEI, but, as practice shows, it rarely used. Pedagogical potential of educational tours is being able to impact students’ intellectual level, to develop their emotional sphere, to shape of conscious attitude to environment constituents, to do environmental awareness upbringing.

Virtual tours are one of the most effective ways to present cognitive information, these are a multimedia photo panorama where one can place video, graphics, text, links. But unlike a video or a regular series of photos, virtual tours are of interactive kind. It goes without saying that in course of the tour one can zoom in or out any object, check some details in more profound manner, zoom in the object under study [55].

Virtual tours are widely represented in the visual arts. In particular it may be museum video tours (see fig. 7). However, virtual tours into nature is seems to be quite perspective and can be used in future biology teachers’ vocational training.

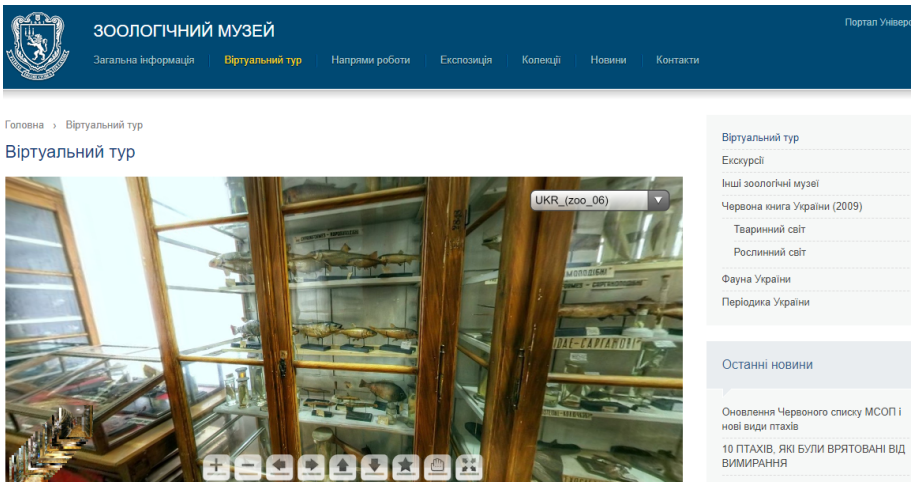


Fig. 7. Virtual excursion in KSPU Zoology museum [72]

As on date virtual tours into nature are available at the Zoological Museum of Lviv National University named after Ivan Franko [72], the Museum of the Human Body in the Netherlands, the State Darwin Museum, the London Museum of Natural History, the Chornobyl' National Museum, the Biological Museum named after K. A. Timiryazev, Nature museums in Yekaterinburg, Yalta Zoo, Virtual Carpathians, etc.

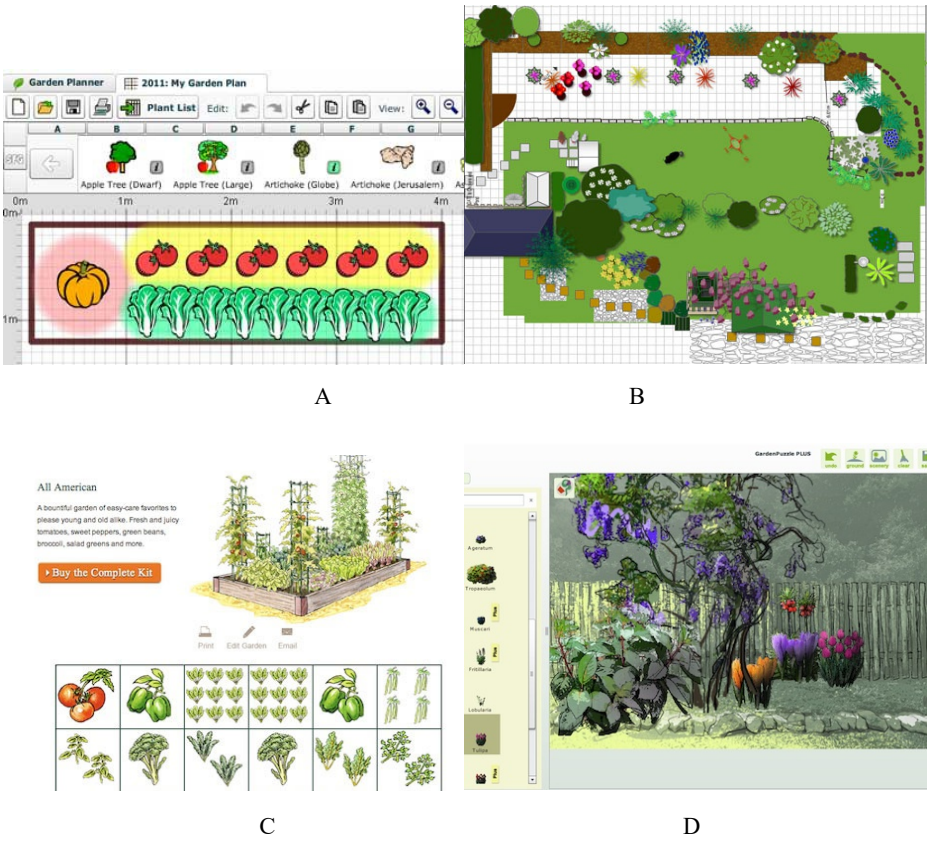
Analyzing the presented content, it should be noted that the above tours can't be described as virtual ones to the full extent, because they don't have interactivity component. They only allow you to view indirectly these museums exhibits collection or other objects.

But, in any case the development of virtual tours into nature or natural museums-based tours may be helpful for students to accelerate perception of learning material. Considering realities of present day, the elaboration of full-blown virtual tours into nature is only matter of time.

5.3 Use of free software for the organizing terminological work with students

Science teachers must be educated specialists who as good as they can incarnate the potential of modern natural sciences. For example, in study the subject "Basis of Agriculture" it is advisable to use such free software that facilitates processing of theoretical material on the principles and typology of crop rotation.

Let's do review a list of freeware and shareware programs and apps, likely can be used to consolidate some knowledge of fruit crop rotation and planning a school study-experimental lot. These programs include *GrowVeg, Garden Planner Online, Kitchen Garden Planner, Garden Puzzle, Sprout it, Garden Tracker* and *Edyn Sensors* (see Fig. 8).



A B

C D

Fig. 8. Free software: *My Garden Plan* (A), *GrowVeg Garden Planner Online* (B), *Kitchen Garden Planner* (C), *Garden Puzzle* (D) [47]

One of the most popular apps is the *GrowVeg* landing planner [14] allowing to add objects, vegetable bed types, and rearrange objects for the perfect location. The program calculates the appropriateness of neighbouring plants. Based on data obtained from local weather stations, app depicts the sowing time for a particular area. Basing on the rational crop principles, the system offers the placement of the following crops, taking into account the predecessors. Via e-mail the app can send reminders about what and when to plant throughout the season.

The lot planner *Garden Planner Online* allows adjustment size, shape and location of lot. Available elements are reckoned shrubs, trees, flowers, and fences. It enables to place both vegetables and fruits. Knowing specific crops planting area, it is possible to calculate the amount of seed for planting via this app.

The *Kitchen Garden Planner's* is online planting planner covers nearly three dozen garden beds. It is designed for organic garden planning. There are 15 cells in each garden bed where vegetables can be placed. The app also offers the detailed planting guidance and does to give recommendations refer to the agrotechnics of each crop growing.

The *Garden Puzzle* provides maximum visualization planning of lot and drawing-up one. The range of available plants includes garden crops, garden, flower and ornamental plants.

The reminder app the *Sprout* fully customizes plant care and so it is very convenient for beginners. The database covers a fairly large list of plants and offers a timetable for land treatment, tunes them in line with a weather data and alerts user in case their changes.

The popular *Garden Tracker* app allows planting planning and monitoring at area up to 2500 m^2 in size. It also enables beds marking and selection a list of crops from a wide database. The program tracks the date of planting and includes many settings, namely: a monthly calendar, and an illustrated database of pests and organic remedies. This program is a fee-based one and allows processing of lot images by experts' help, providing specific guidelines for particular area planning.

Modern technologies using for the automation of organic farming are represented by the *Edyn sensors and software*. Planning crop rotations and crop locations can be conducted based on online monitoring outcomes. These sensors enable data obtainment on weather conditions directly from a location, to determine soil acidity and what's more – darkening of plants.

Really, the representatives of free software discussed above are easy to use, built on the principles of gamification; and are able to introduce novelty elements into the educational process. Working with such apps the future biology teachers can to carry out mental experiments to check virtually made predictions.

5.4 Social Networking – online help for user groups

The use of social networks for educational purposes provides the opportunity to expand the contacts circle in line with students' preferences or their professional interests. In particular, the Ukrainian Biodiversity Information Network (UkrBIN) community is represented on the social network. Amateurs and scientists help with identification of living organisms by photo as well as with filling in the UkrBIN database. Such profile social groups like Dendroflora of Ukraine and the World, Flora of Ukraine, Herbarium Management in Ukraine, Ukrainian Botanical Group, Mushrooms of Ukraine, Plants of Ukraine and others (see fig. 9) are being quite active.

Becoming the members of such a community, future biology teachers not only more deeply study specifically subject knowledges, they thus join a cohort of specialists who enhance knowledge of animate nature and contribute to its protection.

5.5 An empirical study of Virtual Learning Environments application effectiveness in course of future biology teachers' vocational training

In order to analyze the effectiveness of VLE and tools that have been used in students' terminological work in vocational preparation process throughout 2018-2019, the systematic surveys, observations and assessments have been conducted. The monitoring spectrum was included:

1. Students' questioning about their motivation to study professional terminology.
2. Identifying the level of awareness and particular ICT tools ownership by students.
3. Analysis of students' terminological awareness.

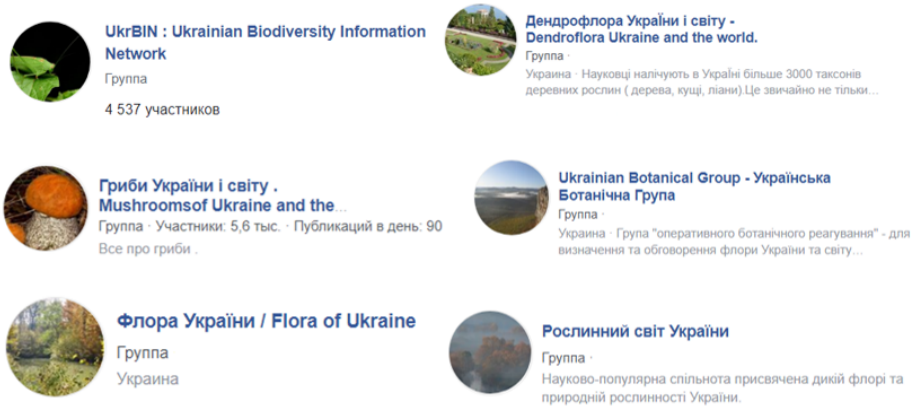


Fig. 9. Biology user groups [12]

Having analyzed the outcomes, eventually, we can be drawn following conclusions: if VLE and tools be actively introduces into the educational process, a tendency to be about increase of future biology teachers' motivating level appears to studying professional terminology.

Comparison of professional terminological training self-analysis outcomes was conducted in the first and third semesters based on following key questions (it was suggested to be rated on a 10-point scale) (shown on Fig. 10).

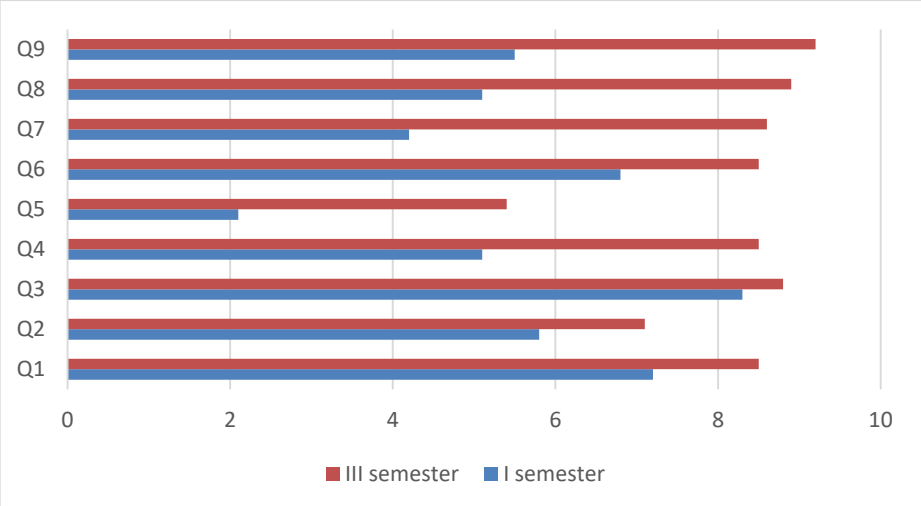


Fig. 10. Dynamics of students' motivation to study and use professional terminology upon VLE-based vocational training completion (it prepared by authors)

1. What do you think about importance of biological terms application in your future professional activity?
2. Fix the level your willingness to speak in a professional way.
3. How do you value your speaking skills and ability that required for future professional work as a teacher?
4. How do you assess the capability of Latin biological terminology in your future professional activity?
5. How can you evaluate your experience of binomial nomenclature awareness?
6. How do you appraise your level of biology terminology preparedness?
7. Fix the level your readiness to use biological terminology and binary nomenclature in your future professional activity.
8. To what extend do you consider Latin as a mean to get new professional information?
9. In your opinion, how important is the ability to use Latin biological terminology and binary nomenclature in the teaching profession?

It has also been found that the use of VLE technologies has led to a significant growth of level of students' terminological competence (see Fig. 11).

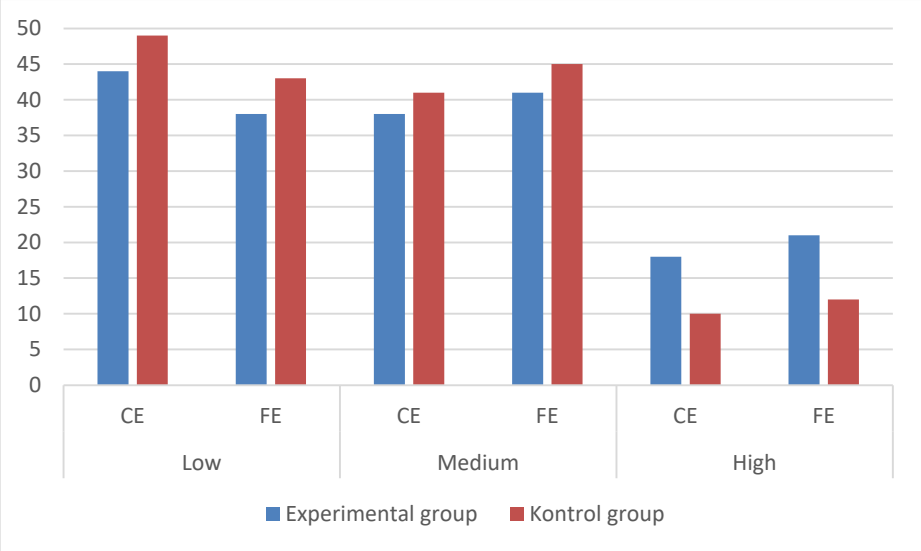


Fig. 11. Dynamics of levels of students' professional-and-terminological competence: CE – Control experiment, FE – Forming experiment (it prepared by authors)

These results are correlating with the growth of students' computer competence.

6 Conclusions

Peculiar feature of teacher's professional competence is the focus on practical skills

formation, basic knowledge about the general principles of ICT application in biology, the formation of individual pedagogical approach. Definitely, application of E-learning systems and Virtual Learning Environments opportunities is consistent with the traditional values of HEIs and has the proven potential to enhance both the effectiveness and efficiency of meaningful learning experiences of students.

Virtual Learning Environment can be defined as a self-contained computer based online environment enabling interactions between instructor and learner. It can be presented as a set of components, such as: the Data-based component, the Communication-based, the Management-and-Guiding ones, and the virtual environments.

The system of Virtual Learning Environment is contributed to efficiency of handling with the students' real educational problem situations, which can be sorted out with digital devices and gadgets.

This study presents an analysis of only a few elements of the virtual educational environment those are appropriate in the terminological work of future biology teachers. Nevertheless, significant potential of professionally oriented e-courses, online definers (guides), UkrBIN National Biodiversity Information Network, mobile apps, digital virtual herbariums, virtual biological laboratories and virtual cognitive tours to shape of future biology teachers' terminological competence has been revealed.

However, it is determined the E-learning cons shouldn't be neglected since the application of ICT and tools cannot be referred to all training courses, not all lecturers and students are ready to use E-learning solely; ICT and tools' high dependence on technical infra-structure of HEI take into account also be considered.

Mastering in vocational training courses of future biology teachers' is distinguished by the need to carry out microscopic, laboratory studies and observations, examination of herbarium specimens and catalogue specimens, nature tours. Thus, integration rather than the complete replacement of traditional educational activity with E-learning is becoming the perspective trend of future biology teacher's professional training upgrade.

In view of that reason we have researched the ways organizing of educational process in Virtual Learning Environments as well as done theoretical substantiation and illustrated practical implementation of its methodology in blended learning. The effectiveness of shown above Virtual Learning Environment and tools that have used in students' terminological work has been confirmed by the pedagogical experiment's outcomes.

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