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The Use of IT-technologies by Natural Sciences Teachers of Arzamas Campus of Lobachevsky State University of Nizhny Novgorod in the Educational Process

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Abstract

The research is urged by the modern requirements concerning the implementation of the competence approach in the context of the Federal State Educational Standard for Higher Education, where special attention is paid to IT-technologies and the information of the educational space development. In this regard, this article aims at identifying the success of the introduction of a number of IT-technologies into the educational process towards natural science cycle teachers training, retraining and advanced training. The main methods used in the study of this problem are the following: concretization and generalization of the data; questioning and testing, monitoring the progress of the educational process and analysis of the results of educational activities of students; study of the experience of certain educational institutions; conducting ascertaining and forming experiments.

The article shows that the pedagogical community of different educational levels is ready for the perception and use of new modern IT-technologies, despite the fact that not all educational institutions have the necessary technical capabilities for their successful implementation. It is revealed that not all IT-technologies are adapted for introduction in educational process. The active use of various information technologies in the educational process at the faculty of natural geography, the interest of students in their development and further use in their future professional activities are also revealed. The materials presented in the article make it possible to organize innovative platforms for teachers' training in a number of educational organizations for implementing the most appropriate information technologies and improving the information competence of teachers.

Keywords: technology; Moodle platform; QR-code; cloud technologies; Thinklink platform; GIS-technologies; QGIS system.

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Introduction

The Russian strategy of education development is based on the international experience and takes into account national traditions, such as continuity, interdisciplinary character, fundamentality, and complexity. The intellectual potential of the nation, which is primarily created with the help of the education system, becomes a determining factor in the progressive development of countries and peoples. Traditional education does not meet the requirements of modernity. Building human future requires active, qualitatively new educational activities (Ilyin, 2015).

The Internet and IT–technologies are simply the most developing fields of modern education, which is stated in Federal, state, and regional programs, numerous articles, conferences, and seminars (Veleslavova, 2008). The XXI century is the age of information technologies and continuous education (self-education). Nowadays it is impossible to imagine an educational space without modern IT–technologies and telecommunications, which open up other opportunities for education, communication and have a high pedagogic potential.

Purpose and objectives of the study

In this regard, this research aims at identifying the success of the introduction of a number of IT-technologies into the educational process towards natural science cycle teachers training, retraining and advanced training.

Literature review

The high level of students training in universities is the key to the successful functioning of the education system. The realities of the new day require preparing competitive professionals, combining professional competence with high culture and active citizenship, thinking and ability to self-studying and self-realization. However, in modern conditions, the process of professional qualities improving and personal abilities development should occur throughout life as over time basic knowledge and skills become insufficient to perform new professional tasks, they need constant updating. The activating factor of teachers' self-development and the stimulus of their professional-developing motivation are information rich social and professional space and the need to master modern technologies (Ivanashko, 2014; Maley, 2014).

According to the relevant requirements for the competence approach implementation in the context of the implementation of the Federal state educational standard of higher education, fundamental changes in the organization and management of the educational process, in the work of teachers, where special attention should be paid to information technology, are necessary, as the importance of information competence of graduates – future teachers who carry out their professional activities within the framework of the widespread introduction of IT-technologies in the educational space of a modern school increases.

Communicative, information literacy and competence are the basis of professionalism in the modern world. In higher education institutions, where future teachers are trained, students should be provided with all the necessary conditions for the use of technical capabilities of computer equipment and communication, search and information for developing communicative and cognitive abilities and the ability to make decisions quickly in different situations (Zakharova, 2008). These conditions are also stated in the Federal state educational standard of higher education (levels: undergraduate and graduate) concerning "Pedagogical education" field. Thus in the "Requirements for the conditions of the Bachelor degree program" paragraph it is specified that each student should be provided with individual unlimited

access to the electronic information and educational environment of the University from any point where there is access to the "Internet" information and telecommunication network (Order of the Ministry of Education and Science of the Russian Federation, 2018).

Lobachevsky University has long been conducting systematic work on the development and improvement of the quality of training of students through the introduction of new, modern forms, technologies and teaching tools, including electronic educational content and the Internet. For improving its competitiveness among the world's leading scientific and educational centers, Lobachevsky University of Nizhny Novgorod pays great attention to the development of e-learning (including mobile). The University is continuously working to improve its network infrastructure. Arzamas campus of the University has a corporate telecommunications network, which unites more than 500 computers. The bandwidth of the external channel to the Internet is currently 100 megabits per second; the bandwidth of the channels connecting the UNN buildings is one Gigabit. Works on the expansion of local networks of hostels making possible to use the Internet practically at any time are carried out. All this provides an opportunity to create an electronic learning environment for students and teachers which allows to simplify access to educational resources, provide support for independent work, organization of an individual and group interaction among students and teachers, effectively use Internet technologies to solve professional problems (Shvetsov, 2014).

Methodology

The process was performed with the use of the following methods: theoretical, diagnostic, empirical, experimental and methods of graphical representation of the results. The analysis and synthesis; concretization and generalization of the received data; questioning and testing, supervision over the course of the educational process and the analysis of the results of educational activity of students; studying the experience of certain educational organizations; ascertaining and forming the experiments.

Modern information and communication technologies are widely used for implementing above-mentioned conditions in the Arzamas campus of the University of Lobachevsky at the faculty of Natural Sciences and Geography concerning of the educational process organization in certain disciplines of Bachelor and Master Degree programs, as well as training and professional retraining programs. All this makes it possible to reveal the students' creative abilities in the educational process and introduce teachers to new digital educational resources.

Results

The creation of educational applications opens up a range of opportunities to improve the educational process and the education system at the faculty as a whole. One of the most effective ways to implement information technologies in the educational process is the development of online courses on the Moodle platform in the e-learning system of the University, which is used by teachers both during lessons and in extracurricular independent work, and represent the interaction of the flows of training and organizing the educational process of information using a remote computer (server).

Moodle is a course management system known as a learning management system or virtual learning environment. It is a free web application for creating websites for online learning. Any teacher has the opportunity to create an electronic resource of the discipline with subsequent placement in the program (Dunaeva & Kamaliev, 2018).

Course elements contain a variety of learning activities for monitoring, self-monitoring,

communication, and feedback. The use of such courses makes it possible to use the full potential of audiovisual tools, tests, additional information on the subject developed by the teacher in accordance with the program. Thus, the "Short course on vertebrate zoology" and "Invertebrate zoology" for first and second-year Bachelors of "Pedagogical education" include 13 and 14 topics, respectively, covering the entire educational material of the studied Zoological disciplines (Figures 1, 2).
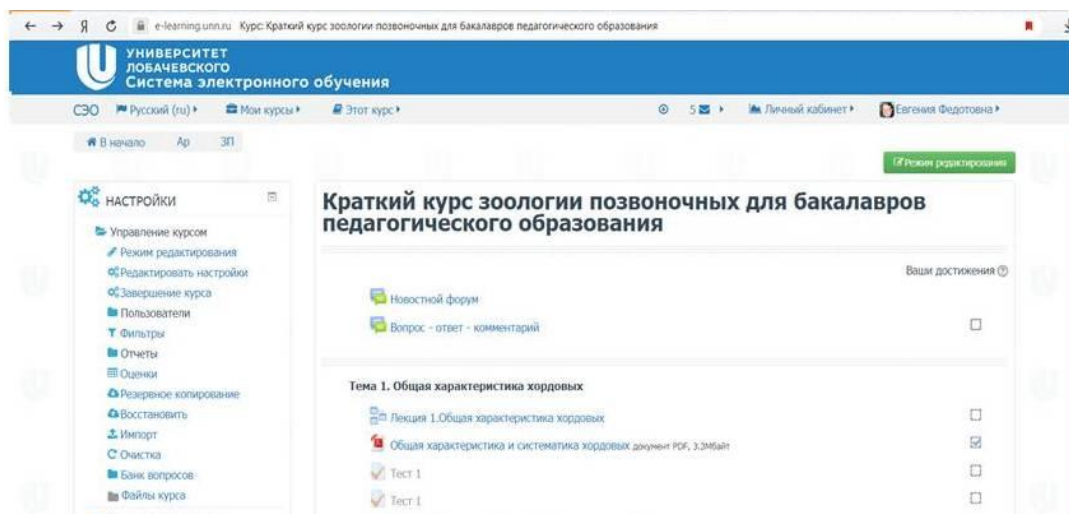

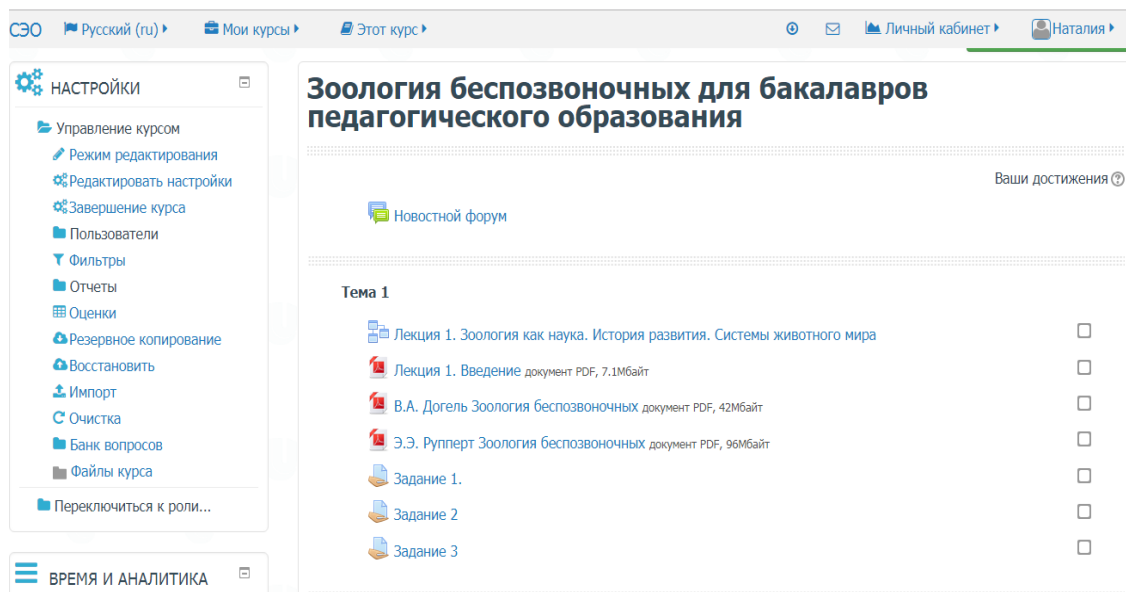Figure 1. *Home page of the "Short course on vertebrate Zoology" electronic course*

Figure 2. *Home page of the " Invertebrate zoology" electronic course*

Each topic consists of a lecture, linked to a video, educational publications, articles from online

resources, tasks in the form of essays, test items, tabular and illustrative material to move to the next topic, as well as tasks for practical work on the studied issues. Fulfilling the tasks, except for the final one, is not limited in time, but there are two attempts. It is necessary to overcome a certain point threshold, which is different for intramural and extramural students. The final test is limited to one academic hour.

Students can access the course and work on it at any convenient time, while the teacher controls all steps and actions, sees whether the presentations and films have been watched or additional material read, and also grades works, essays, and tests that require a detailed response (Figure 3).

Figure 3. *Student's page of the electronic course*

The teacher sets a minimum score, below which a subject is not considered as successfully completed. If all attempts to pass the intermediate thematic test are used, the teacher may allow one more attempt. For each completed topic, a score is set, points are summed up and the average score for the entire course is displayed. Points are summed up in order to form a mark.

Three years of experience in the use of Zoology courses show that the final grade of 90% of students corresponds to that obtained in the exam. If the student has attended all classes, successfully completed the e-course and received a high grade, he may not pass the current exam. Rating score is counted as the final in the discipline. The part of students who pass the exam, trying to improve their assessment, as a rule, with rare exceptions, receives a rating corresponding to the rating, which makes it possible to ascertain the effectiveness of the use of e-course, especially for extramural students, who for a number of reasons may not always be present in the classroom.

The 13 topics of the "Short course on vertebrate zoology" include such important generalizing topics as "The evolution of organ systems", "The origin of chordates" and "The chord tree", in the study of which students write essays using new modern data on these controversial issues. The "Invertebrate zoology" course includes a developed Atlas of micro-preparations to perform practical tasks for students

who do not have the possibility to work in the classroom.

Internet communications have also become an indispensable means of media education in Arzamas campus of Lobachevsky University and are now increasingly being introduced into the educational process. The widespread use of the mobile Internet and portable devices opens a lot of opportunities for the developing the educational trend – Mobile Learning, which is easily implemented in the learning process and makes it more effective, functional and interesting.

Modern university students actively use the IT environment, having access to the information field at any place thanks to mobile devices. Mobile IT technologies used in the field of education include the technology of QR codes – coding information using special programs or services in the form of black-and-white or color squares, which can then be quickly recognized by the mobile phone camera (Burlutskaya, 2016).

During laboratory lessons of the zoological cycle, including training field practices, QR-technology – QR-codes, which places the teacher on paper printed sheets, students read using mobile devices code labels and access to the necessary information is used (mostly in the form of photos of objects, bird voices, links to the Internet, on the job for independent work) (Figure 4).

Занятие 19. Систематический обзор птиц
ПЛАН

Работа 2. Голоса птиц. Прослушать записи голосов птиц и записать в буквенном выражении песни: зяблика, пеночки-трещетки, пеночки-теньковки, обыкновенной овсянки, чечевицы, синицы большой.

Синица большая Пеночка-теньковка Пеночка – трещетка Зяблик

Чечевица   Обыкновенная овсянка   Чиж

Figure 4. *List of methodical recommendations on "Vertebrate Zoology" discipline*

For the "Microbiology" course, a "Workbook for Microbiology laboratory classes" educational manual was published, where the technology of QR codes to access students to the subject of questions for classroom work and additional necessary information of the theoretical block is also used (Figure 5).
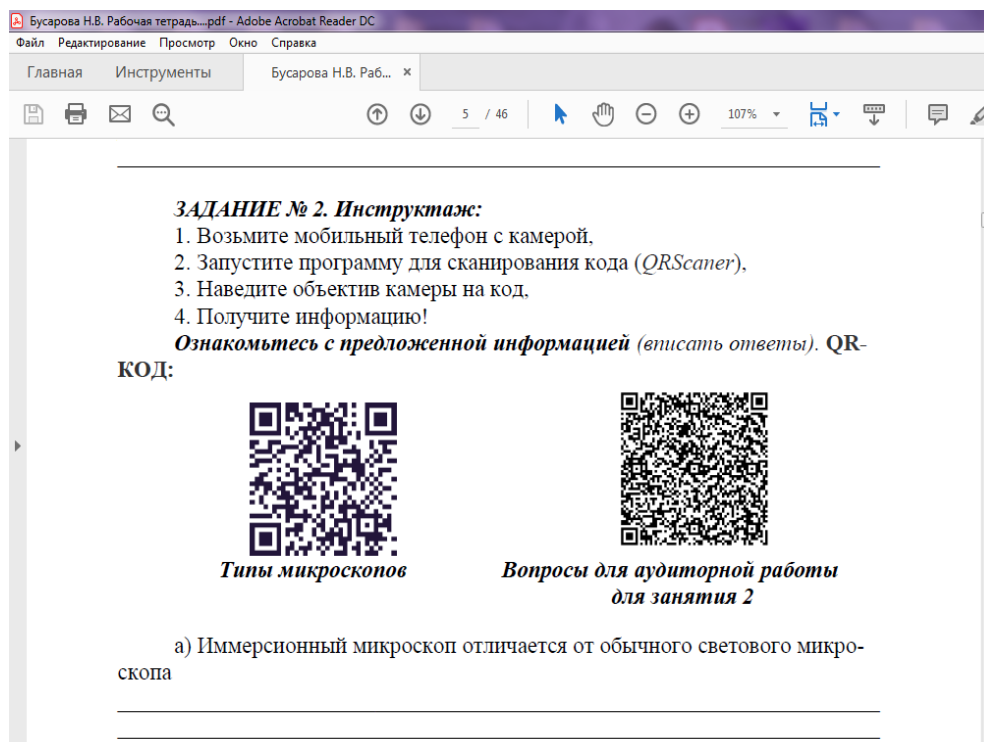
Figure 5. *Page of the "Workbook for Microbiology laboratory classes" educational-and-methodic manual*

Currently, much attention is paid to cloud technologies (Cloud computing) – a technology of distributed data processing, where computer resources and power can be used as an Internet service, which is actively used in the educational process in such disciplines as "Biology teaching methodic" and "Invertebrate zoology". The process of forming the information cloud is carried out on the Thinklink platform and includes a set of links, the content of which is reflected when you click on the link at the site. These technologies are used in the lecture course, as well as for the organization of joint work with students during practical classes for finding the necessary information on the topic, modeling and development of didactic material, and technological maps.

Thus, during practical classes on "Biology teaching methodic" with the topic "Use of information and communication technologies in the learning process" students first get acquainted with these technologies through the "Web-technologies in biology class" information cloud (Figure 6) – online service, which contains links with the theoretical information base on the proposed topic of the lesson. In order to work with the information cloud, the only necessary thing is access to the Internet. Disclosure of information is carried out by clicking on links to external information tabs. Each tab opens as a new information cloud. And then the students independently perform the task of creating an information cloud to certain topics of the school Biology.
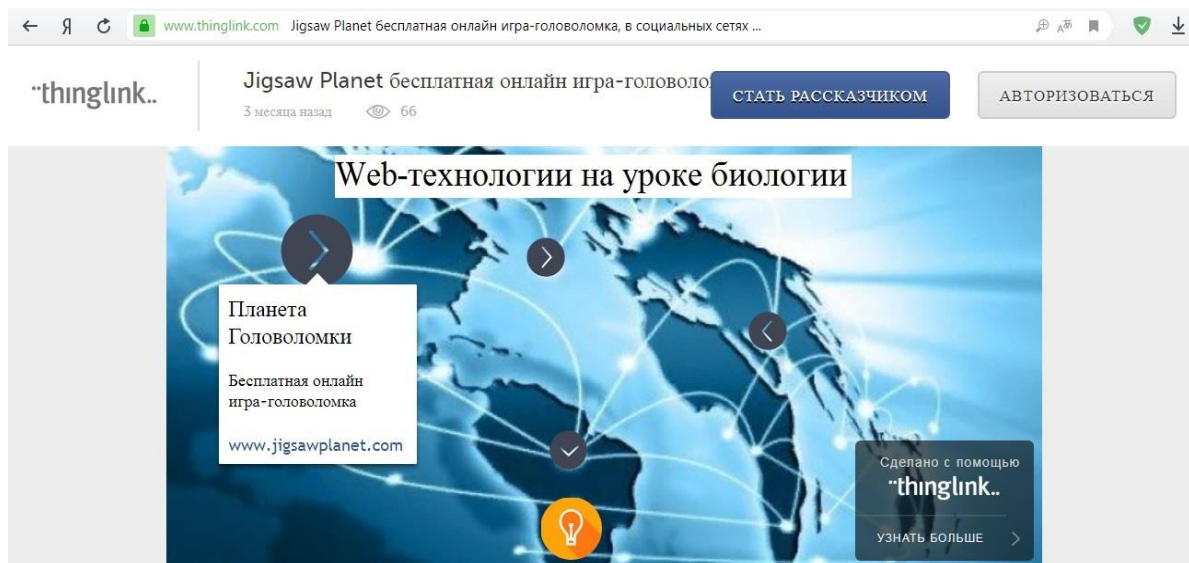
Figure 6. *Homepage of the "Web-technologies in biology class" information cloud on the basis of thinglink.com (https://www.thinglink.com/scene/1126415801637666818)*

This network makes it possible to demonstrate joint remote work in groups on one platform, as well as the possibility of network collection of information from many educational process participants with the implementation of the current control (Busarova & Reshetina, 2018).

Field training sessions in a number of the natural science cycle disciplines and geography can be carried out using modern geographic information systems (GIS technologies). All information obtained in nature about the fauna can be attributed to the category of GEODATA as objects of study using geo-information mapping – a special method of research. Thus, during the lesson of vertebrate zoology devoted to the study of birds, methodological support for the students' work on the preparation of ornithological charts using QGIS geographic information system through a free raster image was developed and tested. In our opinion, this system is a good prospect for further use in the educational process, as the ease of use of the interface makes it possible to perform manipulations of raster and vector images, load and use modules and geodatabases, create thematic maps and much more. It is free, accessible and not difficult to learn for students (Swidinskaya & Brui, 2014).

In order to work with QGIS, a graduate of the natural-geographical faculty Magnini developed guidelines with all necessary aspects to build action cards. Methodical recommendations were tested with second-year students.

The use of interactive presentation in teaching students the interface of the QGIS program gave positive results, expressed in a more effective understanding of the material, both the program itself and the peculiarities of work in it in the implementation of practical works, which makes it possible to assess the positive aspects of the use of geo-information mapping in the analysis and presentation of biological information for scientific research, as well as for activating the mechanical processes of working with geo-products.

The product of the result of the practical training on the topic "The basics of work on the creation of an ornithological schematic map through the use of a free raster image" is presented in Figure 7.

10. Сохранение и экспортирование готовой карты

«Макет → экспорт в изображение → имя: Карта → папка «Нижегородская область» → сохранить».

Figure 7. *An approximate sample of a finished project*
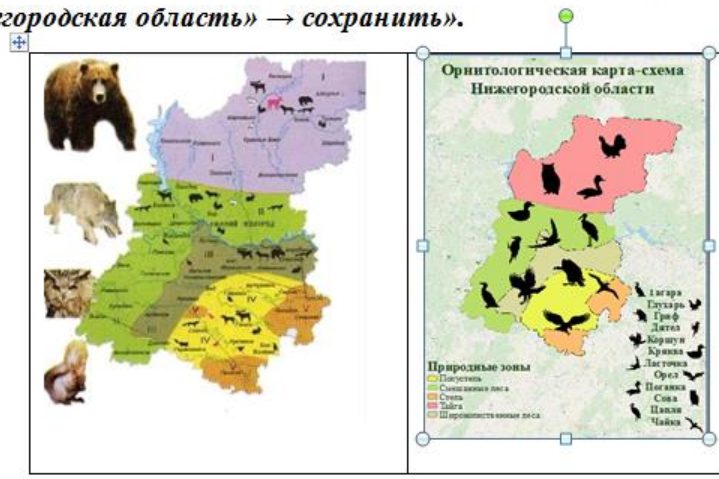
Figures 8-10 represent the results of the student's research on the species composition of birds In two districts of the Nizhny Novgorod region with the creation of a digital ornithological map of the studied areas of Shatki and Arzamas areas.

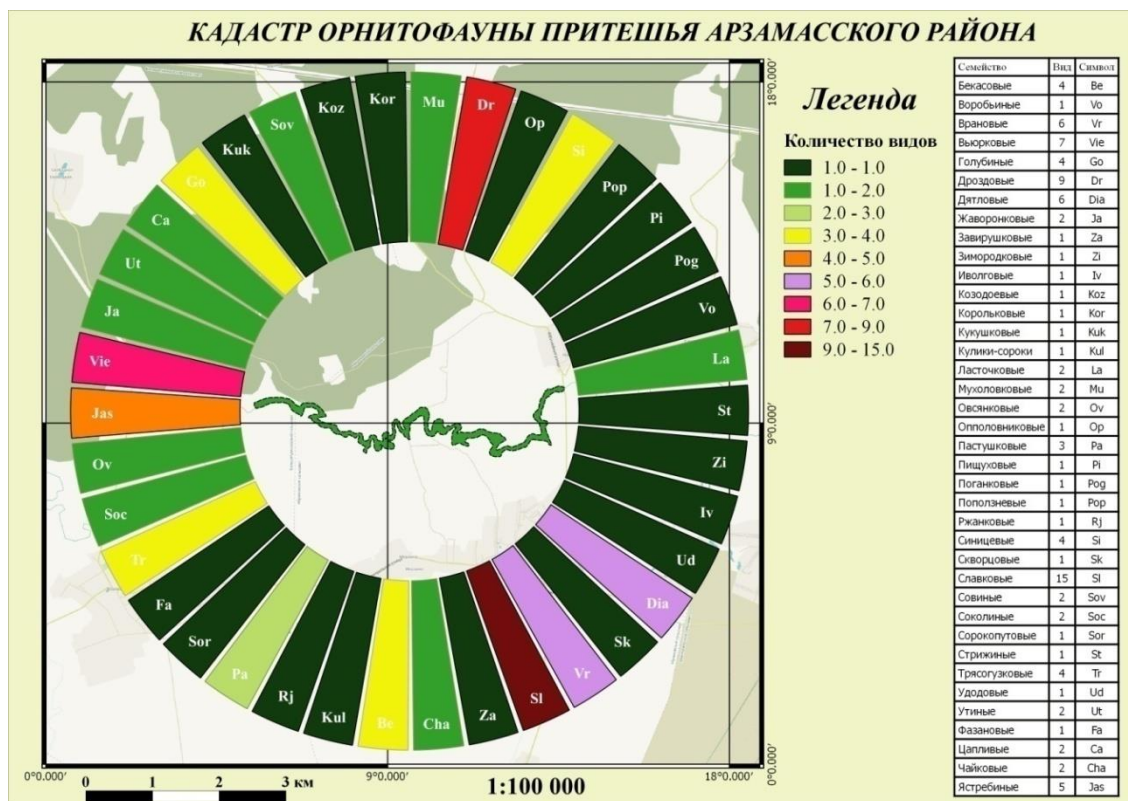Figure 8. *Digital ornithological map of the studied areas*

Figure 9. *Cadastre of avifauna on the digital map of Arzamas areas*

КАДАСТР ОРНИТОФАУНЫ ПРИТЕШЬЯ ШАТКОВСКОГО РАЙОНА

Легенда

Количество видов
- 0.0 - 0.0
- 0.0 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- 4.0 - 6.0
- 6.0 - 7.0

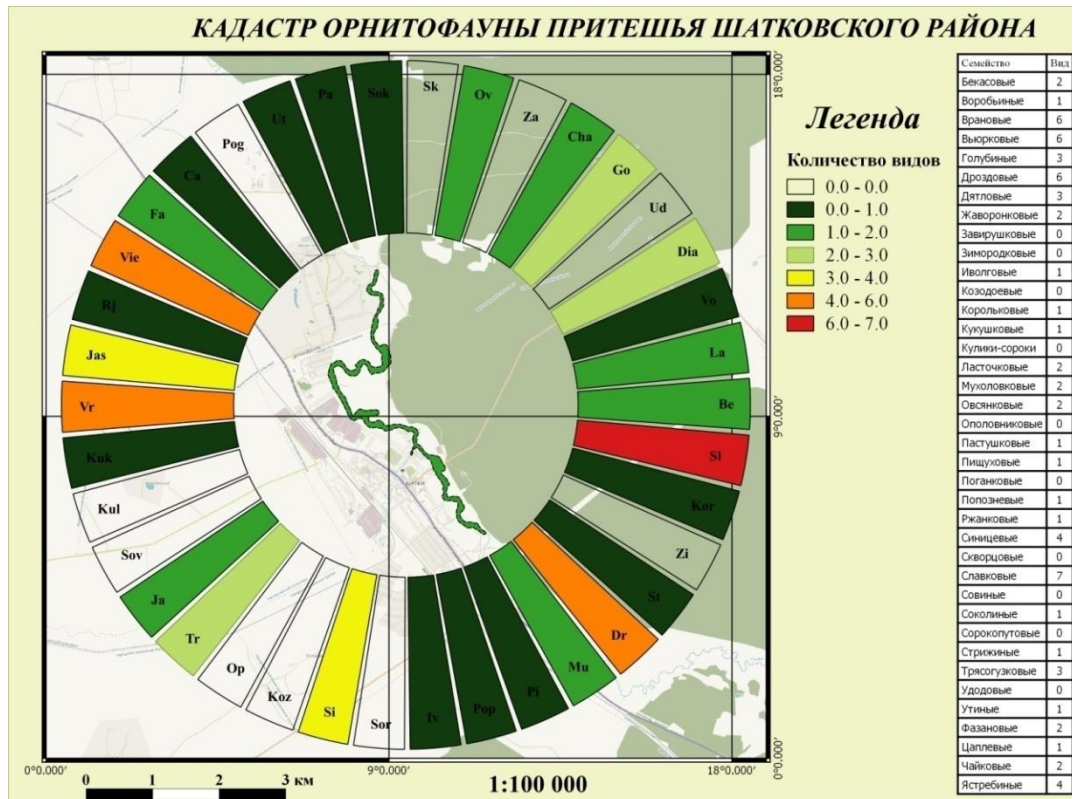| Семейство	Вид
Бекасовые	2
Воробьиные	1
Врановые	6
Вьюрковые	6
Голубиные	3
Дроздовые	6
Дятловые	3
Жаворонковые	2
Завирушковые	0
Зимородковые	0
Иволговые	1
Козодоевые	0
Корольковые	1
Кукушковые	1
Кулики-сороки	0
Ласточковые	2
Мухоловковые	2
Овсянковые	2
Ополовниковые	0
Пастушковые	1
Пищуховые	1
Поганковые	0
Попозневые	1
Ржанковые	1
Синицевые	4
Скворцовые	0
Славковые	7
Совиные	0
Соколиные	1
Сорокопутовые	0
Стрижиные	1
Трясогузковые	3
Удодовые	0
Утиные	1
Фазановые	2
Цаплевые	1
Чайковые	2
Ястребиные	4

1:100 000

Figure 10. *Cadastre of avifauna on the digital map of Shatki areas*

In the study of the question of the possibility of using GIS technologies in the practice of higher education, a questionnaire was conducted on a specially designed questionnaire by natural science teachers of Russian universities to identify the evaluative side of this issue.

This questionnaire was provided to 200 universities of the country with classical departments of geography, Zoology, botany and pedagogical universities with faculties off Biology, but the response was received only from 45 teachers from different universities. The analysis of respondents' answers showed that at the present stage in the practice of higher education teachers of the natural science cycle are familiar with the concept of "GIS technology", but only 35% are used in their activities.

It should be noted that QGIS (more than 50%) is among the most popular GIS technology products. A more detailed analysis of the use of GIS technologies in teaching revealed that 66.7% of respondents are focused on the use in research and development activities, but not in the classroom. The survey also showed that 90% of teachers would like to use GIS technology in further teaching and research activities. Based on the above statements and the identified overall assessment of the importance of GIS-technologies in teaching, it was concluded that it is necessary to introduce GIS-technologies in the educational and research process of higher education, which will help to put forward the entire system of higher education to a new information level.

All of the above technologies and algorithms for their use in the school course of natural-science field provided to educators in passing their programs of professional skills improving and professional retraining also apply in the framework of the innovative project work in educational institutions for the solution of the main tasks of education modernization and the purpose of creation of informational

educational environment of schools through networking. We organized master classes for subject teachers of different educational cycles, during which the possibilities of using modern IT–technologies through networking were discussed.

Discussions

The analysis of various information sources on the studied question makes it possible to reveal the debatable moments in practice of work of the educational organizations of different levels, teachers of the higher school and teachers in application of IT-technologies. On the one hand, everyone understands that modern education is impossible without their implementation in the educational process, on the other hand, not all educational institutions have special technical capabilities and not all have the necessary skills to work in the IT environment for the implementation of the above technologies. The study revealed that a number of information technologies (GIS) are used among teachers of higher only for research because of the limited classroom hours devoted to the disciplines.

Conclusion

According to the results of the research, the pedagogical community of different educational levels is ready for the perception and use of new modern IT-technologies in spite of the fact that not in all educational organizations have technical conditions for their successful realization. Nevertheless, teachers take upgrading courses, where there is training in various IT-technologies (distance learning, Web-quests, cloud technologies, mobile technologies), participate in seminars and master classes with great interest, realizing that modern level of education requires fundamental changes in educational activities organized at different levels of education.

Active of the above technologies by Arzamas University campus teachers of natural science cycle shows the success of their implementation and the interest of students in their development and further use in their future professional activities.

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