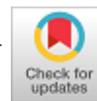# Application of GIS Means for the Research Competencies Development of Ecological Specialties Students

I. Lapyga

Abstract: *The Modern teaching concepts of students at the university provide for the training of specialists who can independently solve problems, that may arise in their further research activities. Application only traditional methods in the educational process is not enough for the scientific research competencies development of students. This article shows one of the possible ways means of geographic information systems (GIS) using in the educational process for developing research competencies students for the proposed methodology. As a result of the experiment, it was found that the combined use of GIS means in the educational process, in particular, the Normalized Difference Vegetation Index (NDVI) and the Green Seeker Handheld device, allows students to see result the practical application of the formed research competencies and the importance of their development for society. The proposed methodic for applying GIS in the educational process can be useful for studies aimed at solving the problems of introducing other tools into the educational process, in particular, the Vegetation Soil Salinity Index (VSSI) and Normalize Difference Snow Index (NDSI).*

Keywords: *Research Competencies, GIS Means, NDVI, Earth Explorer, Green Seeker Handheld.*

I. INTRODUCTION

One of the difficult tasks of reforming higher education in Ukraine is to improve the educational process in the university, where which significant attention must be paid to improving the formation and development of research competencies students.

As Bulvinskaya notes [1], the main category of the competency-based approach to education is competence, which, within the framework of the qualifications of the European Higher Education Area, is defined as a "dynamic combination of knowledge, skills and abilities" of a specialist to unleash professional tasks independently, that is, offline. An important role in the formation and practical development skills of students is played by the university educational environment. In accordance with Yaroshenko [1] the educational environment which focused on the effective research activities of university students, has three main blocks:

1). Social environment;

2). Spatial-subject providing;

3). Resulting.

The main components block of the results, that is, the system of rewards and rewards for the achieved scientific results, are aimed at enhancing the independent and scientific research students' activities. A spatial-subject support block covers the resource base, educational, methodological and scientific support, as well as means of information and communication support.

In modern conditions intensification of science development and increasing the complexity level of scientific data, it is no longer sufficient to use only traditional methods in the educational process to form practical skills. This is evidenced by the appearance of more facts' problem exacerbation of the development effectiveness research skills in university students. In particular, Yaroshenko revealed that 41,22% of university students surveyed consider the conditions for performing research work unsatisfactory [1].

The negative consequences of applying only traditional methods in educational research are manifested in the independence lack and initiative of students. Such students are able to plan, organize and conduct scientific research only under the supervision of a teacher.

In articles devoted to the study of the problems' effectiveness development research competencies students of the university, the authors focus mainly on the analysis of means to identify the competence level, in particular, Hauser et al. [2] disclose the advantages of using the questionnaire method for measure the students' level research competencies. Gess et al. [3] accent attention on the use of the quantitative and qualitative determination method of the subject-oriented component of research competencies whit using test items. Avalos et al. [4] reveal the prospects of using the Lean Startup method as a methodology for the formation of digital and research competencies in students. Espacios et al. [5] having analyzed existing approaches of stimulating students of an engineering university to conduct research, propose using a special functional model that develops creativity. Lasambow et al. [6] have accented attention on the use of the developed standard model of assessing research competencies to enhance their main components. The attention of Swank et al. [7], has directed to measuring the students' competencies level and revealing advantages the proposed scale of research competencies using statistical analysis procedures.

Analysis literature data and the results of our research at the Department of Ecology of the National M.P. Dragomanov Pedagogical University showed that insufficient attention was paid to solving problems the formation and development of scientific research competencies students of ecological specialties.

Based on our own material [8], [9] and other literature data [10], [11], it can be noted that the use of computerized information systems in the educational process can help solve the problem effectiveness development of research-practical skills at university students.

The revealed contradictions between the importance of the research activities of students of ecological specialties at the university and the insufficient level of their skills development practical implementation of research tasks in the ecological field, necessitate the use of modern computerized information systems, in particular GIS.

II. PROBLEM INSUFFICIENT EFFECTIVENESS OF RESEARCH ACTIVITIES STUDENTS ECOLOGICAL SPECIALTIES AT UNIVERSITIES

At the preparing future specialists of ecological specialties in National M.P. Dragomanov Pedagogical University in the Ukraine, the curricula, and programs provide for the formation of students not only knowledge, skills, but also professional research competencies. At the same time, our results of testing students have shown that their level of research competencies is not high. It was assumed, that this could be due to the insufficient use of professionally directed computer applications in the educational process. This assumption had is supported by our observation results, in particular, it was revealed that when preparing for lecture, laboratory, and practical classes, students mainly use the Word, Adobe Reader, Paint, PowerPoint tools, designed to create text documents, graphic images and presentations. During the practical classes, it was revealed that students very rarely use the means of applied computerized programs to carry out measurements and calculations of various research studied factors of environmental pollution. At the same time, students concentrated most attention on the correctness of creating and using presentations for their reports. In our opinion, mastering the practical skills of using the above-mentioned computer applications is not enough for students to develop independence, as well as the research activities competencies.

Ecological research traditionally envisages, monitoring air, soil, plant, or water pollution using various measuring instruments. In particular, we have already described the use of a spectrophotometer in a previously published article [12]. Modern scientific approaches to environmental monitoring are based not only on the systematic recording of the measured pollution the studied object indicators, but also on a description of its geographical component, that is, spatial coordinate data using computerized GIS means. Therefore, insufficient attention to the formation of practical skills among students of using software applications and GIS means in professional activities can obviously be considered as one of the factors' development of an insufficiently high-level scientific research competencies in future ecological specialists. In the context of Ukraine's integration into the economic space of the EU countries, this can lead to low competitiveness of Ukrainian specialists, economically non-lucrative on the European job market, as evidenced by the low percentage of their participation in international grants and projects aimed at improving of condition ecological environment [13].

III. CONCEPT OF RESEARCH ACTIVITIES DEVELOPMENT STUDENTS ECOLOGICAL SPECIALTIES AT UNIVERSITIES

Now Ukraine is implementing a concept for the development of research activities of subjects of higher educational institutions, developed on the basis of the "Europe 2020 Strategy" [14]. One of her tasks is to enhance the development level of research competencies students in university. To accomplish this task, some researchers [1] suggest involving scientific issues in research programs for training specialists of various educational levels, adjusting the education content in accordance with scientific research, introducing educational and methodological support taking into account the main types of competencies, creating methodological materials for organizing and managing scientific-research activities. From the above it is seen that these recommendations are directed mainly to teachers. In our opinion, this is not enough for students to develop the skills of independence and autonomy in carrying out research activities. We believe that for the implementation of this concept, more attention should be directed not only to the research activities of teachers, but also of students. In particular, students of ecological specialties for the development of scientific research competencies need to independently study the scientists' publications, which reveal the experience of choosing scientific problems, determining their relevance, developing tasks and choosing effective methods for conducting experiments, analyzing results and reflecting conclusions. At the planning environmental monitoring, need to give preference to the use of modern measuring instruments, which provide the ability to display the results in computerized systems and scientific research networks. In addition, students of ecological specialties need to pay special attention to the formation of practical skills in using GIS means for processing and displaying the spatial-coordinate data of the studied objects on geographical maps. It should be emphasized that the use of server GIS application means in ecological research not only reveals the possibilities of organizing networked partnership collaboration between students on the decision of educational tasks, but also facilitate the development at the future ecologists' research competencies, information and communication capabilities.

IV. RESEARCH METHODOLOGY

The research work provided for the consistent use of observation methods, conduct an experiment whit application GIS computerized means.

Evaluation of the effectiveness of the developed methodology application was carried out by the method of testing the development level of scientific research competencies among students.

The results of this testing were analyzed using object modeling and comparative analysis methods. Differences in the results of testing students' competencies at the beginning and finish of the experiment were calculated using the correlation coefficient (r). The reliability of the results of the experiment was determined using Student's t-test.

V. RESULT AND DISCUSSION

The target of this work was to assess the appropriateness and effectiveness of the GIS means use, in particular, the Normalized Difference Vegetation Index and the Green Seeker Handheld sensor in the educational process for the development research competencies students of ecological specialties at the university. It was assumed that the use of computerized means will also facilitate the development of students' communication skills.

A. National M.P. Dragomanov Pedagogical University of the Kyiv city in Ukraine

To conduct a given experiment as a base have is chosen the Sub Faculty Ecology of the National M.P. Dragomanov Pedagogical University in Kyiv, where during the 2017/2018 academic year, students of ecological specialties of the "Magister" level took part in the experiment. The results of the experiment showed that, compared with the control group, students of the experimental group, for whom more attention was paid to the formation of using GIS means skills, had higher indicators according to testing results the level development of research competencies.

B. Implementation of Research Activities Development Concept Students of Ecological Specialties at Universities

With the entry of Ukraine into the European scientific and educational space, the volume of scientifically directed educational material that students must master independently has increased significantly. Taking this into account, to increase students' motivation and provide them with opportunities to implement their own research results into practice, it was introduced into the use of GIS means in the educational process. In particular, one such means is NDVI. The use of not only the Green Seeker Handheld sensor [15] but also NDVI in practical works for determining plant biomass during monitoring contributed to the development of students' research competencies and practical skills in determining levels of forest productivity, the irrigation and reclamation land effectiveness, of the agricultural productivity, systems crops, quantitative assessment of the pollutants effects on plant cenoses and crop forecasting.

C. Methodical of Application GIS Means for the Research Activities Development of Students at the University

The methodical of using GIS means in the educational process, aimed at enhancing development the research competencies students of ecological specialties, provide for its implementation in the following sequence:

1) Downloading to a personal computer satellite channels with photographic images of the studied territories;
2) Calculation of the NDVI index by the formula using the program Earth Explorer;
3) Performing a comparative analysis of the data calculated by NDVI and measured using the Green Seeker

Handheld;
4) Creating maps with the displayed data of estimates and dynamics forecasts of the studied objects development;
5) Quality control of requests and reports created using GIS means;
6) Preparation of the obtained data application to solve the studied scientific problems in practice (it is recommended to place the results of the study in scientific computerized networks for public evaluation).

The effectiveness of the above methodical was checked by student testing. At the experiment beginning, the testing results of formatting level scientific research competencies showed that in the control and experimental groups, the value of this indicator, respectively, averaged $40,5\pm3,10$ and $38,6\pm2,03$ points out 100 that is, the experimental group, the competence level was lower by only 4,7% compared with the control group. At the final experiment stage, after applying GIS means, the test results showed that in the experimental group, the average value of the research competencies development increased to $78,2\pm2,64$ points, and in the control group only to $51,6\pm1,72$ points (fig. 1).
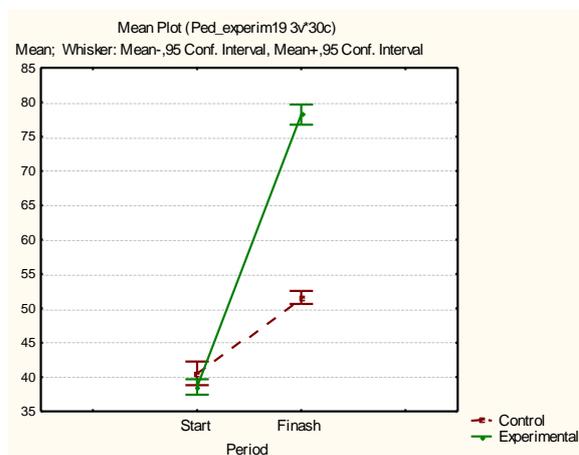
Fig. 1 Changes of the testing results development of scientific research competencies in students of ecological specialties of the National Pedagogical M.P. Dragomanov University at the start and final experiment stages of the 2017-2018 educational year

Analysis of the above data showed that in the experimental group students scored 51,6% more points compared to the control group. The difference between the obtained test results of students in the control and experimental groups is confirmed by the correlation coefficient $r=+0,42$ and the significance level $p\leq0,01$, calculated by the Student t-test criterion.

Taking this into account, increasing the efficiency of the formation and research competencies development is obviously associated with the use of GIS means in the educational process according to the proposed methodology. A similar positive effect of the GIS means uses for the practical skills' formation of solving social students' problems was revealed by Demirci et al. [16] during the implementation of the project in the school of district Sisli.

The study results, obtained by Whitaker [17] in two North Carolina classrooms, showed that use of GIS means in the educational process also facilitate solving the verbal perception information problems and formation of relationships between students.

VI. CONCLUSION

In general, the use of GIS in the educational process according to the proposed methodology can be considered as one of the promising ways to develop the research competence in students of ecological specialties at the university. A results' analysis of the experiment showed that the differences in the NDVI values measured by the Green Seeker Handheld sensor and calculated in the Earth Explorer program based on satellite channels have slight differences, confirmed by the correlation coefficient r=+0,89 (p≤0.05). The combined use of the aforementioned hand sensor and photographic soil surface images from satellite channels shows students the importance of practical application importance of the generated theoretical knowledge to effectively solve the topical scientific problems. In addition, the use of GIS means in the educational process provided an opportunity for students to post the received data on a server and open access to them for other researchers, which also contributes to the development of their communication skills. This article supplements the discussion about the need to use GIS means in the educational process for the practical skills' formation of determine the yield of cultivated crops, as well as the appropriateness of their use for research competencies development of environmental specialties students at the university. The developed and introduced by us into the educational process of the methodology joint use GIS means, in particular, satellite channels, as well as the Green Seeker Handheld hand sensor, does not exclude, but complements the traditionally uses methodical of forming research competencies students of ecological specialties at the university. The obtained positive results of the satellite channels experimental use and a hand sensor for calculating NDVI showed that the proposed methodology for their use in the educational process can be useful for researchers who are looking for solutions to the problems of developing students' professional competencies specialties, with possibility of use and other GIS means, in particular, Vegetation Soil Salinity Index and Normalize Difference Snow Index.

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