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HORIZONTAL NETWORK ORGANIZATION FORM OF UNDERGRADUATES' RESEARCH ACTIVITIES BASED ON INTERDISCIPLINARY INTERACTION

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Abstract

The article is devoted to the problem of organizing network interdisciplinary interaction in the process of research work of undergraduates. Aiming to improve the organizational and methodological tools for the development of research competencies of undergraduates in philology, the authors propose their own concept and specific ways to solve the problem: to form new skills of research activities based on the integration of professional and interdisciplinary knowledge using a horizontal network form of research work. The organization of a "virtual" research space within the framework of network interaction of program participants is carried out through the creation of web discussion platforms, web seminars, where managers pose professional problems to undergraduates in the humanities, and undergraduates of other professional fields provide technical or mathematical assistance in solving them with further critical discussion of problems and their assessment. The article illustrates interdisciplinary research tasks for philology students based on textual analysis and computer modeling of I. A. Bunin's journalistic texts. A distinctive feature of the conducted research is the implementation of a network format of dialogical interaction of participants through critical discussion and practical solutions from various points of view of interdisciplinary professional problems. The uniqueness of the presented approach lies in the fact that for the first time in the practice of teaching undergraduates of opposing training professional fields (mathematical and humanitarian), actual ways to overcome the isolation of scientific cultures have been found.

Keywords: Integration of science and education, network form of training, research activity

1. Introduction

Digitalization, which defines the basis of the existing reality, actualized interdisciplinary cooperation in the process of cognition of the world and man. The challenges of modern society dictate a focus on the convergence of knowledge, the dialogue of scientific cultures. Understanding the problem of interdisciplinary interaction of sciences is inseparable from the integration of technical and humanitarian knowledge, and its solution should lead to communicative interaction within the post-disciplinary unity.

The dialogical interaction of the humanitarian, information and mathematical cultures creates conditions and mechanisms that can form a modern style of thinking, create the basis for the development of a future specialist-researcher, deeply and multi-functional mastering professional activity, enriched with constructs of a new quality, characteristics and forms of becoming a higher level of educational and professional motivation, individualization of pedagogical support.

Future journalists, for example, should be aware that the space of their activities is radically changing under the influence of digitalization. Now journalism, as the most technologically advanced of the fields close to philology, is increasingly applying mathematical approaches to the analysis of the information environment. Before our eyes, a new science is being born — medialogy. Mathematical modeling has thoroughly declared itself in this emerging scientific direction. The professions of future philologists (linguists, literary critics), which are not directly related to technical innovations, also experience a digital impact, primarily at the level of information collection, processing and storage. Against this background, mathematical research methods that allow us to find accurate digital confirmations of certain philological hypotheses are actively used in the process of cognition of the phenomena of literature, and mastering them is possible and necessary already in the student years by mastering integrative courses.

The experience of using such courses based on the combination of philological and mathematical knowledge in the system of training mathematics teachers has received scientific justification and proved its effectiveness (Dvoryatkina et al., 2017). Modern philology as a whole, as a type of intellectual activity based on the study of the text, acquires new ways of development in the format of interdisciplinary interaction.

The modern line of integration of education focuses on interdisciplinary approaches, voluminous, multidimensional, versatile study of subjects and phenomena. The need for a dialogue of humanitarian and mathematical knowledge is actualized. The process of digitalization of information, which has affected all aspects of life, has become an objective basis for this kind of dialogue. In it, the mathematical sphere "demanded" philological knowledge, and the philological sphere — mathematical knowledge.

The implementation of interdisciplinary interaction is most promising in the process of integrating educational and research activities, primarily at the master's and postgraduate levels. At the same time, the specifics of specialization, of course, remain decisive, and the scope of integration concerns additional, in-depth foundations of professional training. An effective form of improving the quality of university training of specialists on the basis of combining educational and research activities in the context of digital transformation of the education system is network training, focused on virtual self-organization and interaction of young researchers from different fields of knowledge.

2. Problem Statement

The analysis of the available foreign and Russian studies devoted to the network form of the organization of the educational process allowed us to distinguish two main approaches to its definition.

The term "network learning" is understood by Russian scientists as a synonym for e-learning, mainly remote, based on the use of various Internet technologies (Bogomolov, 2006; Ponachugin & Voroshilova, 2016). The same approach is followed by many foreign researchers whose works are devoted to network interaction in education. For example, the Western concept of network learning (Dirckinck-Holmfeld, 2016; Levy, 2003; Steeples & Jones, 2002) is based on "the integration of information and communication technologies to establish connections between students; between students and teachers; between the learning community and its learning resources". The authors emphasize that the most successful practices of network learning use interactive educational materials, therefore, network learning is based on information technologies that should support interdisciplinary interaction and dialogic learning (dialogue with each other, the student with the teacher, as well as with the learning environment).

Russian researchers (Loginov & Efremov, 2014; Yakovleva, 2016) hold an alternative opinion on the essence of network learning, based on a model approach that expands the remote form of interaction between participants through:

- a model for implementing joint educational programs through network training and retraining;
- a model of interdisciplinary learning and equalization of the quality of learning by attracting stronger subjects to implement the educational program in a network format in certain areas of knowledge for educational or research activities.

This approach to the implementation of the network form of education is defined in Article 72 of the Federal Law "Education Act". It also specifies the essence of the network form of implementation of educational programs, in which "the learning process is based on one basic educational organization – the operator of the implementation of educational programs in the network form, and for its implementation, other educational organizations are involved – the key subjects of the implementation of the educational program in the network form". Thus, we can distinguish two enlarged models for the implementation of educational programs in a network format:

- Model 1: integration of educational programs ("educational organization — educational organization");
- Model 2: the use of resources of other organizations in the process of implementing educational programs ("educational basic organization — other organization").

The first model of network interaction is implemented in two modes – horizontal and vertical. The horizontal network model involves the interaction of several educational organizations of the same level (similar in scale of activity); the vertical interaction model involves organizations of different levels.

Horizontal network integration involves the involvement of young researchers from different fields of knowledge, actualizing the need to move from thematic to problematic forms of scientific research, promoting synergy of theories and methods of different fields of knowledge, which allows you to form a holistic view of the object of research. A new form of research activity that allows you to achieve the

essence of professional knowledge and the depth of the study of the problem is possible on the basis of a network approach and interdisciplinary interaction.

The above mentioned allowed us to formulate the *problem of the study*: how to design a network learning environment that reflects the basic principles of interdisciplinary interaction and contributes to the effective formation of research competencies, successful professional training of undergraduates in philology in the context of digital transformation of education.

3. Research Questions

The study focuses on the following issues:

- Does the methodological and technological approach to the disclosure of the essence of the network form of the implementation of educational programs in the context of a digitalized dialogue of cultures change?
- What forms of organization of virtual research space within the framework of network interaction of participants of master's programs will be the most effective?
- What interdisciplinary research tasks based on textual analysis and computer modeling of I. A. Bunin's journalistic texts can be offered to students of philology?
- Is it possible to use similar interdisciplinary professional tasks in other areas of training, implemented in a network format?
- How to assess the formation of research competencies of undergraduates studying within educational programs using the network dialogue of cultures?

4. Purpose of the Study

The aim of the research is to improve the organizational and methodological tools for the development of research competencies of undergraduates in philology in the context of interdisciplinary interaction based on a horizontal network approach.

5. Research Methods

The following methods were used in the study:

- theoretical and methodological analysis and systematization of knowledge — comparative, retrospective, modeling, on the basis of which the need for the development of a network form of organization of research activities of students in the context of interdisciplinary interaction is established, the prospects for the introduction of this form are shown. Textual analysis, analysis of standards, curricula, educational and methodological literature established the effectiveness of the network form for the integration of research and future professional activities;
- practical (observation, conversations, analysis and description of the products of activity) and experimental research, its ascertaining, searching and training options.

The study involved undergraduates-philologists, undergraduates of applied mathematics and computer science ($n_1 = 45$ и $n_2 = 50$) full-time students.

The average age of the trainees was 23.2 years, and the samples were almost gender-balanced. An essential characteristic of the samples was work experience in the professional field. Among students of philology studying for a master's degree, 30% have never worked; among mathematicians, more than 50% worked in the professional field.

6. Findings

Professional training of a master's student is, first of all, the process of mastering various types of research activities. The research activity of a master's student in philology is based on a deep profile-theoretical training in the course of training, on a broad interdisciplinary knowledge base, on practice-oriented attitudes and multicultural scientific communication. The fundamental research competence of modern undergraduates is an in-depth system of knowledge in their professional field, as well as the ability to organize on this basis the search for a solution to a problem in an interdisciplinary field of knowledge. This, in fact, determined the choice of the content and forms of students' research work implemented at Bunin Yelets State University.

High-quality, well-thought-out organization of research work of undergraduates, focused on the creation of complex innovative products, requires a non-standard interdisciplinary approach. This problem can be solved by organizing a network form of interaction between master's programs of various professional fields and their direct participants.

The pedagogical model for the implementation of educational programs in a network form was developed taking into account constructivist views on learning (Grabinger et al., 1997) and with the aim of supporting self-managed co-education. The main focus was on the development of new research competencies through immersion in the" virtual" research space. The organization of a new information space for network interaction of program participants is carried out through the creation of web discussion platforms, web seminars, and Internet forums, where managers pose professional problems to undergraduates in the humanities. And undergraduates of other professional fields provide technical or mathematical assistance in solving them with further critical discussion of problems and their assessment. The complex structure of such an event involves the inclusion in its work not only undergraduates of various fields and professions of training and their scientific supervisors, but also professionals from these fields of knowledge (linguists, literary critics, journalists) to contribute expert knowledge to the research work.

The web-platform has become not only situational in experimental training, but also a permanent platform for interaction of future specialists, mentors, and analysts in the development and implementation of joint synchronized master's programs. Web-seminars and online conferences served as a dialogical space for discussing specific experiences, solving problems, and as an effective tool for professional development.

Master's programs in such areas of training as "Journalism", "Philology" (professional field - Philology of text and literary editing), "Pedagogical education" (professional field — Mathematics and Information Technology), "Applied Mathematics and Computer Science", operate as a network within the university since 2015. The teams of the departments of Literary Studies and Journalism, mathematics and methods of its teaching are its developers and ideological inspirers. During this period, we have

accumulated a certain interdisciplinary experience in solving professional problems through the network interaction of program participants.

For example, let us consider the features of the organization of research undergraduates-philologists in the conditions of network interaction of program participants, which establishes the "professional-developing, professional-activity and professional-personal contexts" of the master's activity.

Traditionally, students of philology at the Bunin Yelets State University are focused on the study of the writer's texts. In the jubilee year 2020 (the 150th anniversary of Bunin's birth), the research activities of undergraduates were focused on the problem "I. A. Bunin's journalism in the format of three unities: text context hypertext". The choice of the direction of scientific search relates to the fact that the journalistic component of the creative heritage of the outstanding master of the word is the least studied and requires new, adequate time, approaches to consideration.

Students of philology in our situation are helped to penetrate into the textual depths by students of mathematics. The web-platform becomes a platform for scientific communication of young researchers, some of whom (philologists) offer a task, and the others (mathematicians and computer scientists) perform it. The presented results are the end of the work for mathematicians, and for philologists — the beginning of a new scientific reflection, the basis for confirming/refuting the hypotheses put forward. Thus, in the textual analysis undertaken by philologists, computer modeling is organically included, and an integrative project with the use of digital technologies is implemented. In the end, undergraduates-philologists conduct professional theoretical research, find effective ways to solve the problem, allowing them to ensure the accuracy of the analysis without detailed immersion in the mathematical field of knowledge. In the process of scientific interaction, undergraduates-mathematicians are not only co-authors, but also active "users" of philological knowledge: they are attached to the text as a cultural phenomenon, to the author's style, to the individual perception of a journalistic work, to the critical understanding of the writer's position, to reflection on what they read.

Undergraduates of applied mathematics and computer science in the C# programming language, which, along with the C (C++) languages, is the main one for solving applied problems, developed a computational application — a time style analyzer that allows for stylistic identification of text, predicting changes in the author's style for any time period, and identifying the author's style of works by introducing a time parameter. The results of statistical taxonomy, when texts are taken without taking into account the time parameter, correlated with the results in dynamics, when the time of creation of the work is taken into account, are analyzed and commented on by philologists.

The use of the style analyzer revealed new "problem areas" for undergraduates-philologists. For example, the work of a temporary style analyzer established quite expected results for two works created by the writer almost at the same time — in 1924 and 1925. The obtained empirical value is much less than the critical one ($\chi^2_{emp} = 728,66 < \chi^2_{cr} = 1099,56$) therefore, there are no differences in the statistical (frequency) analysis of the presented texts — "Inonia and Kitezh" and "The Mission of Russian Emigration".

Interesting results were obtained in the statistical analysis of works of different time periods, such as "Speech on the anniversary of the Russian Vedomosti" (1913) and "Inonia and Kitezh" (1924):

$\chi^2_{emp} = 1070,08 < \chi^2_{cr} = 1099,56$. In this case, the empirical value of the Pearson criterion is almost close to the critical value at the significance level of 0.05, therefore, when it is increased to 0.01, the differences will already be significant ($\chi^2_{emp} = 1070,08 > \chi^2_{cr} = 921,67$). In other words, we can say that the writer's style has changed somewhat.

The qualitative commentary (biographical, historical, cultural, etc. necessary to explain the nature) of the obtained statistical results, proposed by the master's students-philologists, allows us to approach the understanding of the author's plan, the circumstances that influenced its implementation. In the specific cases presented above, students of philology give the following comment: quantitative analysis of publicistic texts of I. A. Bunina confirms the hypothesis about the stability and consistency of the development of the writer's ideological and aesthetic views, which were formed in the domestic period of his work and have not changed practically for several decades. For comparison, the texts of the 1920s were taken- the period when Bunin was in exile, categorically not accepting and condemning the Bolshevik coup. The analyzed works are different in subject matter. One of them ("Inonia and Kitezh") concerns literary and aesthetic issues, the second ("The Mission of Russian Emigration") - questions of ideological-political and axiological. Since there are no stylistic differences found in them, therefore, the author's style is not determined by the problem-thematic orientation of the text.

Statistical analysis of the texts "Inonia and Kitezh" and "Speech on the anniversary of the newspaper "Russian Vedomosti" suggests that in the works of different periods of time, but in the general thematic line (past and present of verbal creativity), the writer's style is mostly unchanged. Bunin consistently draws his line, convincingly showing the artistic, aesthetic and moral superiority of classical literature over the literature of modern Russia. For more reasoned conclusions and in order to focus on factual accuracy and verification, students of philology, on the recommendation of the head, resort to the help of a sample of scientific comments prepared by an authoritative research team and given in the book "I. A. Bunin. Journalism 1918-1953".

The assessment of the formation of research competencies was carried out on the basis of the prepared final qualification work of the master's student, in the course of testing the results of interdisciplinary research in the form of joint scientific articles of undergraduates, combined speeches at scientific conferences of different levels, both philological and mathematical professional fields. The main approach in the evaluation activity is three verbs: formulate, model and interpret, which clearly reflect the key types of research activities of undergraduates in solving professional problems based on the dialogue of cultures. They point to the thought processes that undergraduates will typically be involved in when solving research problems.

Verification of the formation of research competencies of undergraduates is also carried out in a prolonged way:

- at the level of reviewing final qualifying works, including the results of joint research activities. More than 40% of the final qualifying papers were prepared on interdisciplinary topics with the support of mathematical modeling methods;
- at the level of discussion when testing them at scientific conferences of different levels. Every year, more than 30% of undergraduates in philology present the results of their research at interdisciplinary conferences (International Multidisciplinary Scientific Conferences on Social

Sciences & Arts (Albena, Bulgaria); annual International Scientific Conference "Fundamental Problems of Teaching Mathematics, Computer Science and Informatization of Education" (Yelets, Russia); annual International scientific and Practical Conference "Development of individual creativity in the modern multicultural space" (Yelets, Russia), etc.);

- at the level of exchange of views between the participants of the joint program using Web-platforms, Internet forums, chats. More than 60% of undergraduates in philology are active participants in IT events of any format: from small meetups to full-fledged conferences.

7.   Conclusion

The study of the network form of the organization of research activities of undergraduates is an urgent problem of modern pedagogical research in both theoretical and applied aspects. To date, we have accumulated some experience in the field of network interaction, which, overcoming autonomy and isolation, allows us to develop, test and offer the professional pedagogical community innovative models of the content of education and management of the education system.

The results presented in this study on the introduction of network forms of organizing research activities of trainees are consistent with both modern Russian (Khoroshilova et al., 2019; Loginov & Efremov, 2014; Ponachugin & Voroshilova, 2016) and foreign studies (De Laat & Lally, 2003; Fowell, & Levy, 1995; Goodyear et al., 2004; Jones et al., 2001; Levy, 2004). A distinctive feature of the research is the organization of dialogical interaction of participants through critical discussion and practical solution of interdisciplinary professional problems from different points of view in a network format. The uniqueness of the presented approach is that for the first time in the practice of teaching undergraduates in two opposing fields of knowledge (mathematical and humanitarian), actual ways to overcome the isolation and one-sidedness of the two cultures are found. The virtual dialogical meeting of these scientific professional fields only in the conditions of digitalization proved its effectiveness, revealed a synergistic effect in solving complex problems of professional, media education and information and communication training of students.

Digitalization, which has affected all aspects of modern reality, has actualized the issues of dialogue of cultures, integration of sciences in the field of higher education. It has made new demands not only on the technologically intensive natural sciences, but also on the humanities. Digitalization has had a significant impact on the philological sciences, fundamentally transforming the process of collecting, processing and transmitting specialized information. Against this background, mathematical research methods have been actively used to find accurate numerical arguments of philological hypotheses. The preparation of a master of philology as a specialist whose intellectual activity is based on the study of the text, acquires new ways of development in the format of interdisciplinary interaction. All this has led to a radical expansion of the traditional range of methods and forms of organizing educational and research work in a new network format.

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