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The Formation of Methodical Competence of the Prospective Teacher of Science through the Interactive Technologies

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Abstract--- Annotation. The relevance of the research *is determined by the need to identify optimal models for professional training of prospective science teachers in organizing educational activities of schoolchildren in accordance with the requirements of the Federal State Education Standard of the Secondary General Education (FSES SGE). In the context of shortage of class time for studying methodological content in B.Ed. degree programs, there is a need for intensification of educational activities through interactive technologies.* ***Research objective:*** *theoretically substantiate, develop and experimentally test an organizational and pedagogical model of methodological competence development of prospective science teachers through interactive technologies. The developed model implements methodological guidelines for systemic and integrated, competence-based, activity-based, and technology-based approaches. The peculiarity of this model is that a planned result can be achieved through management of interactive technologies in educational activities. This management is based on correlating interactive technologies with teaching methods implemented in the system of higher education (lecture classes, practical classes, independent work of students, internship), and also with potential of those technologies in developing components of methodological competence of prospective science teachers (personality-centered, cognitive, technological, activity-based).* ***Research methods:*** *pedagogical experiment, questioning, testing, content analysis of curricula, methods of mathematical statistics (chi-square).* ***Research results:*** *a set of conditions that allows to intensify development of methodological competence of prospective science teachers by means of interactive technologies has been identified.* ***Research significance:*** *materials of the article can be useful to administrative and academic staff of educational institutions of higher education.*

Keywords--- *Higher Education, Professional Competence, Methodological Competence, Science Teacher, Interactive Technologies.*

I. INTRODUCTION

Interactive technologies are the most effective mechanism for development of methodological competence of prospective science teachers in the structure of multi-level training of higher education. Use of interactive technologies should be correlated with teaching methods implemented in the system of higher education (lecture classes, practical (seminar) classes, independent work of students, internships), as well as their potential in developing components of methodological competence of prospective science teachers (personality-centered, cognitive and informational, functional and technological, activity-based). In this paper, a model for development of methodological competence of prospective science teachers and its evaluation results has been presented. At the

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level of educational content, this model assumes design of educational activities in part of education subjects with methodological content. The peculiarity of this model is that a planned result can be achieved through management of interactive technologies in educational activities.

Modernization of the education sphere of the Russian Federation is aimed at meeting the requirements of the modern labour market and the social demand of participants in educational relations. In the domestic legal space, the social demand has been specified in federal state educational and professional standards, which have been further developed during the assessment period.

Firstly, teacher training in modern conditions must correlate with the requirements of the standards for goal, content, process and result of higher education; secondly, with the FSES SGE, thirdly, with specifics of the subject domain. In this regard, the general problem of prospective teacher training is the problem of determining mechanisms for development of professional competence, because at the level of scientific and pedagogical activities new methodological approaches are being established: activity-based and competence-based teaching, which is regarded as a competitor for the cognitive approach to teaching – the base of the education paradigm [22], [13].

II. LITERATURE REVIEW

In the domestic pedagogical science there is an ambiguous position regarding the essence and content of teacher's professional competence. Some scientists (Sokolov I.I. [7], Solomin V.P. [8], Stankevich P.V. [9], and others) lay emphasis on the subject domain, but most researchers (Vasil'yeva P.D. [1], Vagner E.G. [2], Vereschagina O.N. [3], Kozhevnikova T.A. [4], Mosin V.V. [5], Romanova O.V. [6], Shatalov M.A. [10], and others) consider methodological competence as the key component, integrating results both for subject domain and general pedagogical training of teacher training.

At the same time, the development problem of methodological competence of prospective science teachers is conditioned by the requirements of the FSES SGE, covering, inter alia, specific subject domains. In this paper, attention is paid to development of methodological competence of prospective science teachers, whose professional activities are aimed at teaching Science. A specific feature of future professional activities of bachelors in these fields and specializations is that subject content of their activities includes several disciplines.

These specializations of training are in demand largely due to the fact that they improve employment opportunities for prospective bachelors of education, since such specialists can successfully teach several subjects in one school, including in so-called ‘underfilled’ schools. However, due to the above factors, the problematic field of modern methods of professional education is the search for effective mechanisms for developing methodological competence of prospective science teachers.

Most studies in modern domestic pedagogical science are focused on professional training of prospective teachers of physics, chemistry, and biology – the Science subjects. However, there is the obvious need for a research on effective mechanisms for professional training of bachelor's degree students of such a broad specialization as Science, because of the demand in labour market; integral nature of the science itself, and the corresponding science subject (natural science has been identified as an educational subject by the FSES SGE).

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III. MATERIALS AND METHODS

One of the most frequently used methods of scientific and pedagogical research is pedagogical modelling. Modelling methodological competence development of prospective science teachers based on the object of transformation refers to the local level with a general focus on such a component of educational activity as training.

Students who master the principal B.Ed. educational program in Science are the subject of this model. Methodological competence as a part of professional competence of prospective science teachers undergoes a change within the framework of this model.

Interactive technologies are the specific mechanism for bringing the object and subject of the model to a desired state. The need for interactive technologies in professional training of prospective science teachers is stipulated not only by the nature of the competence-based and activity-based approaches, but also by the specific content of the methodological training of prospective science teachers characterized by integrativity, interdisciplinarity, and multilevelness.

Methodological approaches to development of methodological competence of prospective science teachers are determined by the requirements for professional training of this category of professionals [14]. Undoubtedly, modelling of educational activity in modern scientific practice is based on numerous methodological approaches. In this research, the developed model includes achievements of modern pedagogy, however, it considers the specific methodological approaches as the key research tools (including systemic and integrated, competence-based, activity-based, and technology-based approaches), rather than universal methodological approaches.

Taking into account the methodological policies of these approaches, it should be noted that interactive technologies [17], [16] are the most effective mechanism for development of methodological competence of prospective science teachers in the structure of multi-level training in higher education, since they allow implementing the above approaches.

Assessment of methodological competence development model of prospective science teachers has been carried out at Yelets State Ivan Bunin University for 2016-2018.

Two groups of students have been identified for the pedagogical experiment. A group of 16 bachelor's students that have been studying "44.03.05 Pedagogical Education" program (specialization in Biology and Chemistry) since 2015, has been identified as a control group in the research. A group of 17 students that have also been studying "44.03.01 Pedagogical Education" program (specialization in Science) since 2015, has also been identified as a pilot group in the research.

IV. RESULTS

To implement and assess the designed model of development methodological competence of prospective science teachers based on interactive technologies, an assessment of initial state of the conditions determined at the theoretical stage of the research has been made. These conditions include the informational content and technological component of the implementation of the principal B.Ed. educational program in the form of classroom activities, independent work of students and pedagogical internship. There have been identified following research

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objects: regulatory support for the implementation of the principal B.Ed. educational program, as well as participants of educational relations – academic staff and students.

As the first object for the research analysis, the following three principal B.Ed. educational programs of the Federal State Budgetary Educational Institution of Higher Education "Yelets State Ivan Bunin University have been defined: "44.03.05 Pedagogical Education" program (specialization in biology and chemistry); "44.03.01 Pedagogical Education" program (specialization in Science, Geography).

The construct of the curricula subjects under research clearly demonstrates that subjects of natural science are revealed in a greater extent in the differentiation aspect, since they are called upon to develop the basis of subject competence of prospective teachers. In these conditions, the main emphasis should be placed on subjects of methodological content, not so much at the content level as at the level of technology, since this block of subjects is aimed at transformation of the substantive content in the methodical representation.

Researching the initial conditions for development of methodological competence of prospective science teachers at the level of regulatory support for the implementation of the principal B.Ed. educational program allowed to identify deficiency status of these conditions. The construct of the curriculum subjects itself does not provide transformation of the subject content into the sphere of professional pedagogical activity of prospective bachelor's degree holders. At the same time, this construct has a potential in solving the methodological competence development problem. There are several specific 'opportunity areas' in the methodological competence development: independent work of students in the content of subjects of Science in terms of integrativity and interdisciplinarity; technological implementation of subjects of methodological content; use of the potential of practical learning [18], [19], [20], [23], [24].

A research on the attitude of teachers implementing the subjects and methodological content of Science allows drawing the following conclusions. Firstly, about half of the teaching staff supports application of interactive technologies in development of methodological competence of prospective science teachers. Secondly, about a third of teachers use interactive technologies in educational activities in full. Thirdly, half of the respondents expressed readiness for self-education in this field, including through cooperation with colleagues.

Identification of the model effectiveness has been carried out using a pedagogical experiment which included the stages of ascertaining, forming, and assessing. As measurable results of the pilot experiment, the following components of the methodological competence of prospective science teachers have been identified: personality-centered, cognitive and informational, functional and technological, activity-based.

The forming stage of the experiment has been implemented taking into account the initial conditions for the 2017-2018 academic year. The first line of research envisioned strengthening the implementation of principles of integrativity, interdisciplinarity and technology in educational activities of the science subjects.

The second line of research has been focused on a revision of the content and teaching methods in the context of the use of interactive technologies in such methodological subjects as "Science: Methodology of Upbringing and Teaching" and "New Educational Technologies in Teaching Science".

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Below are some examples of application of interactive technologies in educational activities of students in the following subjects: "Methodology of Teaching Science", "Teaching Science Using Interactive Technologies", "Methods of Teaching Science for Specialized Classes".

The theoretical learning of science subjects has been carried out through application of problem solving lectures ("Methodological Foundations of Teaching Science"), binary lectures (topic: "Functioning and Connection of the Methodology of Teaching Science with the Methodology of Teaching Social Sciences" has been identified jointly with specialists in the field of biology, geography, psychology), lectures – press-conferences ("Developmental History of Foreign Methodology of Teaching Science", "Developmental History of Domestic Methodology of Teaching Science"), provocative lectures (topic: "The Content of Science Education" has been covered in the context of the comparison of the requirements of the federal component of the SES and the FSES SGE), lecture-discussions ("Personal, Metadisciplinary and Disciplinary Learning Achievements in Science"), lecture-dialogues ("Systemic and Activity-based Approaches in Teaching Science").

Practical classes have been held in the form of seminar discussions ("Principles of Content Selection for Teaching Science", "Methodology Selection for Teaching Science", "A Systemic and Activity-based Science Lesson", etc.), research seminars ("Performance Expectation of Teaching Science", "Educational Activities at Science Lessons"), a seminar workshop ("Eleventh and Twelfth Grade Lesson Plans for Science Subjects"), an analytical workshop on addressing a specific situation (an analysis of situations of effective or ineffective application of methods, technologies, forms and means of teaching science for primary and high school students"). Much attention has been paid to the use of interactive whiteboards, since this training tool has not only a significant potential in teaching students, but is also actively used in general education practice [12], [15].

The following project topics implemented in the form of independent work of students, have been considered: "Arrangement of Extracurricular Educational Process in the Domain of Natural Sciences with Indication of Methodologies and Activities Used", "Project Activities in Science", "Specifics of Educational Activities in Teaching Biology (Chemistry) at the Basic and In-depth Levels," etc.

The case method has also been actively used in the independent work of students, for example "Influence of Teaching Methodology on the Results of the Unified State Exam in Chemistry or Biology". Several social networks have been actively used as an effective media tool for communication with students [11], [21].

V. DISCUSSION

Below are the results shown by respondents of the pilot group during the period of model evaluation. Firstly, harmonious development of all components of the methodological competence has been observed: personality-centered, cognitive and informational, functional and technological, activity-based. Secondly, many students of the pilot group demonstrated productive and creative methodological competence, while methodological competence of the students of control group has been identified as reproductive. The obtained data have been verified using methods of mathematical statistics (chi-square).

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VI. CONCLUSION

Thus, taking into account the analysis of current trends in higher education, specifics of professional training of teaching staff, the proposed model for development of methodological competence of prospective science teachers has been designed and tested. The peculiarity of this model is that a planned result can be achieved through management of interactive technologies in educational activities. This model does not cover the whole spectrum of educational activities of the B.Ed. degree program, but only lectures, practical classes, independent work, pedagogical internships. At the level of educational content, this model assumes design of educational activities in part of education subjects with methodological content.

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