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Methodical Training System Enhancements of Future Biology Teachers at Pedagogical Universities

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Abstract

Background. Methodical training plays a leading role in future biology specialists' professional education; it is assumed to be a backbone component of future educators' professional readiness in modern scientific research. The methodical training of future biology teachers is interpreted as a determined acquisition of methodological knowledge and skills in the context of methodical tasks related to school course of biology and their solving. New tendencies of school biology education development, implementation of innovative pedagogical technologies into teaching process, development of modern training resources provided the necessity to modernize methodical training of future biology educators in pedagogical universities.

The objective of this research is giving a scientific ground to the methodical training system of future biology teachers and checking the effectiveness of its implementation at pedagogical universities.

Methods. During the implementation of this research the complex of general scientific methods has been used: *theoretical* ones (scientific literature analysis, terminological analysis, comparison, systematization and generalization of scientific results), *empirical* ones (observation, discussions, questionnaire, testing for the determination of future biology educators' method competence level, pedagogical experiment with qualitative and quantitative analysis of results), mathematical statistics method. The total number of 482 students of Ukrainian pedagogical universities were involved in the experiment.

Results. After the implementation of pedagogical experiment the number of students with high level of methodical readiness has significantly increased (according to motivation component – by 9,7% cognitive one – by 5,8%, active one – by 6,2%, reflexive one – by 10,5%), with satisfactory level (according to motivation component – by 12,9%, cognitive one – by 25,2%, active one – by 19,3%, reflexive one – by 8,8%); the number of students with low level has decreased respectively (according to motivation component – by 15,9%, cognitive one – by 24,3%, active one – by 20,5%, reflexive – by 11,3%).

Conclusion. According to the results of experiment it can be claimed that implementation of future biology teachers' experimental methodical training system provides the enhancement of students' methodical proficiency level and higher quality of their professional readiness at pedagogical universities of Ukraine.

Keywords: Methodical training, System of training, Methods of teaching biology, Biology didactics, Future biology teachers.

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Introduction

In the context of educational reformation in Ukraine and European integration, the demands to competence of pedagogues, future educators of new competitive generation rises as well. Not only should the teacher of future be the retranslator of knowledge, he also should encourage self-realization of every student and be able to prepare them to the life in modern social and economical conditions. Professional training of future educators should be directed on students' personal and professional development, formation of nonstandard way of thinking, creative approach to the work and elaboration of their own methodical style. Higher pedagogical education is aimed to be a school of professional formation of future educator's personality as well as to provide a successful advancing towards their own professional trajectory.

Methodical constituent plays a leading role in the professional training of biology teacher. In modern scientific researches the methodical competence is regarded as a backbone component of future educator's professional readiness. For this reason, review of conventional methodical training of future biology teachers, adding new content, innovative forms, methods and educational resources is essential nowadays.

Problem Statement

The methodical training of the subject teacher has been widely studied by plenty of Ukrainian researches including M. Krylovets (2009), L. Mykhailenko (2005), N. Morse (2003), V. Sharko (2008) as well as by foreign scientists such as V. Zemtsova (2002), N. Zelenko (2006), Ye. Tamoznia (2010), W. Stawiński (2007), L. Tuszyńska (2010), M. Švecová (2001), K. Ušáková (2014), E. Buchcic and I. Żeber-Dzikowska (2012).

Actual questions of methodical training of future biology educators is revealed in the publications of Ye. Arbuzova (2011), L. Bulavintseva (2011), H. Zhyrska and N. Mishchuk (1999), I. Moroz (2008), A. Stepaniuk (2011), D. Traitak (2002), O. Tsurul (2011) and other scientists. But today the system methodical training of future teachers of biology in institutions of higher education was not the subject of special scientific researches of native scientists.

Methodical training of future educators is one of the most predominant elements of professional competence, which synthesizes all the other components by providing a sufficient preparation for the future educational activity.

The methodical training of future biology teachers is interpreted as a determined acquisition of methodological knowledge and skills in the context of method tasks related to school course of biology and their solving. It includes biology and other natural sciences competence, the awareness about the objective and tasks of school biology course, content of syllabus along with textbooks, forms, methods, instructional techniques, educational resources, ability to utilize this knowledge practically, and formation of future biology teacher's methodical preparation.

Methodical training of future specialists is considered as a system, which encompasses the objective and task, content, forms, resources, methods and technologies of students' education. This system belongs to the upper level of future biology teachers' professional training and functions in its structure.

The objective of methodical training is to form a methodical readiness of future biology educators to their professional activity within a school biology educational system.

The content of methodological training includes the following components: cognitive (methodological competence), active and operational (experience and skills), personal (motives of pedagogical activity, values, professional qualities). Methodical training of students assumes simultaneous development of each of these components, namely, strengthening of students' methodical literacy, development of methodical competencies, formation of values as well as professionally significant qualities of a teacher, creative abilities, methodical reflection and motivation to methodical activity.

The objective and result of the methodical training of future biology teachers is determined by the methodical readiness – the integrated quality of the person, directed at the effective solving of educational tasks with the help of the formed system of methodological competence, abilities, motives and value attitudes, along with the presence of certain qualities and abilities of the teacher, which are necessary for the successful completion of methodical activities of all types (Hrytsai, 2016).

It was established that methodical readiness consists of four components: motivational one (a set of motives and value attitudes for the methodological activity implementation), cognitive one (a system of methodological knowledge), activity one (methodical skills, competence, subject experience, which ensure high-quality performance of professional activity), and reflexive one (reflexive abilities of the future teacher). Thus, the methodological readiness of future biology teachers is characterized by endurant motivation, deep methodical competence, the formation of methodical skills and reflexive abilities.

The objective of this research is giving a scientific ground to the methodical training system of future biology teachers and checking the effectiveness of its implementation at pedagogical universities.

Research Questions

During the study, we need to answer the following questions:

- What is the basis of methodical training of future biology teachers?

- What methodical disciplines are most important in the methodical training of biology students of pedagogical universities?

- What educational technologies are the most effective in the process of training of future biology teachers?

- What pedagogical conditions increase the effectiveness of the methodical training of future biology teachers?

- How to improve the level of methodical readiness of future teachers of biology at pedagogical universities?

- What components constitute the methodical readiness of future biology teachers?

- What is the effectiveness of the proposed system of methodical training of future biology teachers in pedagogical universities?

Methods

During the implementation of this research the complex of general scientific methods has been used: *theoretical* ones (scientific literature analysis, terminological analysis, comparison, systematization and generalization of scientific results), *empirical* ones (observation, discussions, questionnaire, testing for the determination of future biology educators' method competence level, pedagogical experiment with qualitative and quantitative analysis of results), mathematical statistics method.

The theoretically justified system of methodical training of future biology teachers has proved its effectiveness in the context of a pedagogical experiment that has been conducted throughout the period of 2008–2016.

The total number of 482 students of Ukrainian higher educational institutions participated in the experiment (Rivne State University of Humanities, Poltava National Pedagogical University named after V.G. Korolenko, Sumy State Pedagogical University named after A. S. Makarenko, Bohdan Khmelnytsky Melitopol State Pedagogical University, Kryvyi Rih State Pedagogical University, Chernihiv National Pedagogical University named after Taras Shevchenko, Kirovohrad State Pedagogical University named after V. Vynnychenko, Pavlo Tychyna Uman State Pedagogical University). Future biology teachers were divided into two groups: control group (243 students) and experimental one (239 students).

In the experimental group, the content of methodical training was updated, innovative teaching technologies were introduced and an individualized methodically oriented learning environment was

created. It contributed to the development of methodical thinking of future teachers, their creative abilities and methodical reflection. During the experiment the studying process in control group has encompassed traditional methods.

Results of the Experiment

The Stage of Search (Years 2010–2012)

The purpose of the research experiment was to clarify the main components in the system of methodical training of the future biology teachers; develop necessary training methodical provision for discipline «Methods of teaching biology» and other methodical disciplines; prepare the experiment materials for conducting the experiment.

To objectively determine the level of methodical readiness of future biology teachers we substantiated criteria, indicators and levels of methodical readiness, as well as diagnostic tools for their measurement.

To assess the formative level of the components of the future biology teachers' methodical readiness to professional activity we conducted selection and modification of methodologies, as well as the development of our own questionnaires, test tasks etc.

Thus, to diagnose the motivational component of the methodical readiness of future biology teachers we used the questionnaire «Motivation of professional activity» (methodology for determining the motives of professional activity by K. Zamfir, modified by A. Rean) (Rean, 1999), which was adapted to determine the motives of methodological work of future biology teachers; questionnaire «Motivation for achievement in professional activities» (by A. Karelin) (Karelin, 2002); questionnaire «Motivation for success and fear of failure» (questionnaire by A. Rean) (Rean, 1999).

To diagnose the formative level of the cognitive component of methodical readiness, we used a questionnaire for knowledge of methodical terms and concepts, test assignments and writing control papers on biology teaching methods.

The formation of the activity component was determined by solving methodical task, as well as by using a questionnaire on self-assessment of methodical abilities and the evaluation of products of methodical activity (lesson notes, extracurricular activities scenarios, excursion programs, plans for classes, didactic materials, etc.).

Diagnosis of the reflexive component formation was conducted on the basis of students' self-assessment of the formation of their professionally significant personal qualities, a questionnaire «Self-assessment of the creative potential of the individual» (by A. Batarshev, I. Alekseyeva and E. Mayorova) (Batarshev et al., 2007), as well as assessment of the methodical portfolio of the student.

Determination of the formation level of methodical readiness components for future teachers of biology was carried out according to the following criteria: motivational-personal, cognitive-informational, activity-technological, reflexive-creative.

Formative Experiment (Years 2012-2015)

The main purpose of the formative experiment was to study the effectiveness and efficiency of the experimental system of future biology teachers' methodical training in pedagogical universities.

Objectives of the formative experiment:

a) To introduce an experimental system of methodical training of future biology teachers into the educational process of the pedagogical universities;

b) To create certain pedagogical conditions for future teachers of biology methodical preparation and methodical support of disciplines;

c) To apply appropriate diagnostic techniques to determine the level of students' methodical readiness for each of the components identified in the study;

d) To verify the validity of the results of the study using the Pearson criterion.

The program of forming experiment was aimed at students mastering solid methodical knowledge, forming the necessary methodical skills, developing a positive motivation for methodical activities, forming methodical reflections, and developing a unique methodical style. This was achieved by simulating situations similar to school life, conducting business games, working in methodical workshops, solving methodical problems and cases, implementing projects during the study of methodical disciplines, organizing students' independent activities and research work, as well as during the period of pedagogical internship.

Pedagogical experiment involves the use of different forms of training organization and innovative technologies in order to improve the quality of methodical training of future teachers. This allowed us to determine their influence on the formation of various components of student's methodological readiness for professional activity (motivational, cognitive, active and reflexive). One more important factor in it was the introduction of individual author's methodical support for methodical disciplines.

The leading pedagogical conditions for the implementation of the future biology educators' methodical training system are the updating of methodical training content, the introduction of innovative teaching technologies and the creation of an individualized methodologically oriented learning environment at a pedagogical university.

Learning the «Methods of teaching biology» discipline as a key component of students' methodical training along with mastering of other methodologically oriented disciplines combine the incorporation of traditional forms, teaching methods, and new technologies. In the experimental group methodical disciplines include: «Methods of teaching biology», «Methods of excursions on biology», «Fundamentals of naturalistic work at school and extrascholastic establishments», «Innovative technologies of teaching biology».

Within the given experiment the textbooks of «Methods of teaching biology», «Methods of teaching biology with a help of tables and charts», «Methods of teaching biology in question-answer form», «Innovative technologies of teaching biology», «Methods of nature excursions preparation», «Methods of preparation and conducting of biology excursions», a working notebook with a printed basis for independent students' work on «Methods of teaching biology», guidelines for laboratory studies, teaching practice, writing term papers and dissertations that increase the quality of methodical preparation of future biology teachers have been developed, experimentally tested and practically implemented at higher pedagogical educational institutions.

Innovative teaching technologies (interactive technologies, contextual learning technologies, project technology, case-technology, the «methodical workshop» technology, portfolio technology, information and communication technologies, distance learning technologies that contribute to the methodical formation of the future educator has been introduced into educational process.

The technologies indicated above are practice oriented and allow students to discover professional activity better, to reveal their pedagogical abilities and objectively evaluate them, to develop the necessary methodological competencies, to form positive motivation for the future profession and to create their own methodical product (manuals, lessons outlines, didactic cards, visuals).

The introduction of the distance learning elements, particularly through the uniquely designed site, containing educational and methodological materials on method related disciplines is definitely effective (http://grytsai.rv.ua).

According to the results of the experiment, the conclusion about the positive influence of experimental

methodical training system on the level of methodical readiness of future biology educators has been drown. Particularly, the level of motivation, cognitive, active and reflexive component of future biology teachers went up by 23,1%, 32,3%, 28,2%, and 18,9% respectively. Detailed results of the conducted experiment are revealed in a fig. 1.

After the implementation of pedagogical experiment the number of students with high level of methodical readiness has significantly increased (according to motivation component – by 9,7% cognitive one – by 5,8%, active one – by 6,2%, reflexive one – by 10,5%), with satisfactory level (according to motivation component – by 12,9%, cognitive one – by 25,2%, active one – by 19,3%, reflexive one – by 8,8%); the number of students with low level has decreased respectively (according to motivation component – by 15,9%, cognitive one – by 24,3%, active one – by 20,5%, reflexive – by 11,3%).

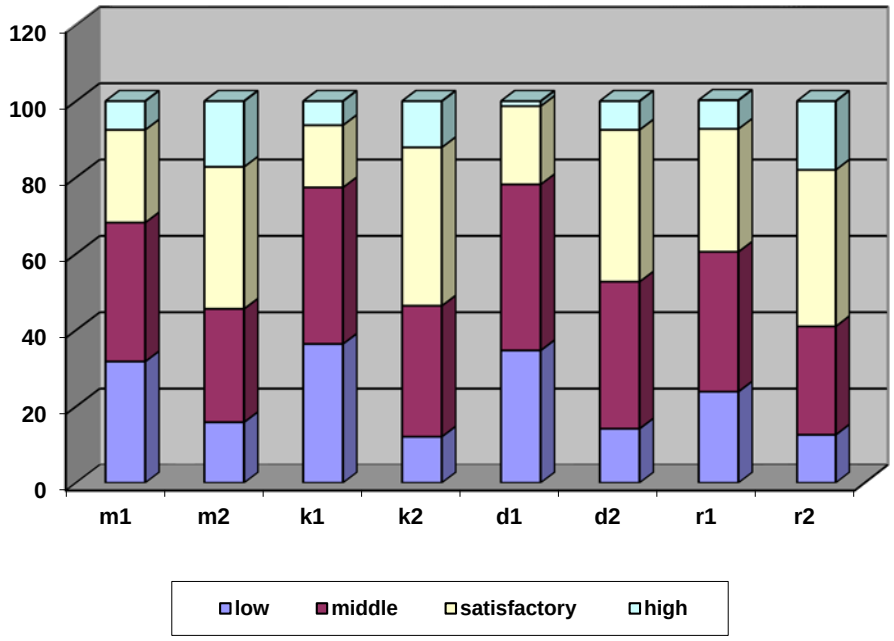

Figure 1. The formation dynamics of experimental group students' metodical readiness components

m1 - the motivational component before the experiment; m2 - the motivational component after the experiment;

k1 - the cognitive component before the experiment; k2 - the cognitive component after the experiment;

d1 - the active component before the experiment; k2 - the active component after the experiment;

r1 - the reflexive component before the experiment; r2 - the reflexive component after the experiment.

Results of comparative analysis for experimental and control groups are showed in the Table 1.

Table 1. The comparison of methodical readiness dynamics of experimental and control groups students before and after the experiment

Component	Level of methodical readiness, %							
	low level		middle level		satisfactory level		high level	
	C	E	C	E	C	E	C	E
Motivational	-1,6	-15,9	-2,5	-6,7	+2,4	+12,9	+1,7	+9,7
Cognitive	-5,3	-24,3	-5,8	-6,7	+8,6	+25,2	+2,5	+5,8
Active	-2	-20,5	-2,1	-5	+2,4	+19,3	+1,7	+6,2
Reflexive	+2	-11,3	-5,3	-8	+2	+8,8	+1,3	+10,5

Hence, the analysis of experimental data and observation materials, the responses of teachers give grounds to assert that the experimental system of methodical training of future biology teachers has positively influenced on the growth of students' methodical readiness.

The effectiveness of the implemented methodical training system was proved by using the testing of statistical hypotheses method according to the Pierson criterion.

Conclusions

The program of the pedagogical experiment involved the implementation of certain pedagogical conditions for the methodical training of future biology teachers (the updating of methodical training content, the introduction of innovative teaching technologies and the creation of an individualized methodically oriented learning environment) in pedagogical universities.

To evaluate the level of formation of each of the components of the future biology teachers' methodical readiness for professional activity, the selection and modification of methodologies (questionnaires, written tests, test tasks, solving methodical problems, self-assessment of methodical skills and evaluation of products of methodical activities, evaluation of methodological portfolio of a student etc.).

The analysis of experimental data and observation materials, along with positive feedback from university professors gives grounds to assert that the experimental system of methodical training of future biology teachers positively influenced the growth of students' methodical readiness.

The formative experiment proved that the introduction of an experimental system of methodical training for future biology teachers will increase the level of methodical readiness of students, and will improve the quality of methodical training of future biology teachers in pedagogical universities.

According to the results of the experiment it can be claimed that implementation of future biology educators' experimental methodical training system provides the enhancement of students' methodical readiness level and higher quality of their professional proficiency at pedagogical universities of Ukraine. The study substantiated and experimentally tested the effectiveness of the methodical training of future teachers of biology. Based on that it is stated that the motivational component of students in experimental groups increased by 23,1%, cognitive – by 32,3%, activity – by 28,2%, reflective – by 18,9%. It confirmed the pedagogical effectiveness of future biology teachers' methodical training system, suggested in this experiment.

Acknowledgments

Authors' contributions

MD-B, NH, MG, IG, WZ participated in the design of this study. MD-B, NH, MGperformed the statistical analyses. MD-B, NH, MG, IG, WZ drafted the manuscript. MD-B, NH, MG were involved in data collection and/or made important intellectual contributions to the interpretation of data and the writing of paper. All authors critically revised and approved the final version.

Compliance with ethical standards

The research related to human use complied with all the relevant national regulations, institutional policies, and was in accordance with the tenets of the Helsinki Declaration. The study protocol was approved by the Ethical Committee of Poltava V. G. Korolenko National Pedagogical University, Poltava, Ukraine. The Ethical Commitee consented in writing to the study.

During realization of tests, all participants provided informed consent and used all measures for maintaining anonymity of participants.

Competing interests

The authors declare that they have no competing interests.

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