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POSSIBILITIES FOR DEVELOPING THE RESEARCH ACTIVITY OF FUTURE CHEMISTRY TEACHERS IN THE CONTEXT OF AN INDIVIDUAL APPROACH

Boltayeva Rano Amirillayevna
Teacher at the Department of Chemistry of Faculty of Natural Sciences at Jizzakh State Pedagogical University, Uzbekistan

ABSTRACT

The preparation of future chemistry teachers requires not only the acquisition of subject knowledge, but also the development of research activity, scientific thinking and the ability to organise inquiry-based learning. In modern pedagogical education, an individual approach is considered an effective condition for revealing students' cognitive potential, professional interests and research abilities. This thesis examines the possibilities for developing the research activity of future chemistry teachers in the context of an individual approach. The focus is placed on the methodological importance of personalised learning tasks, laboratory inquiry, independent scientific search, reflective assessment and differentiated academic support. The thesis argues that the individual approach creates favourable conditions for transforming students from passive recipients of chemical knowledge into active participants in scientific and pedagogical inquiry.

KEYWORDS: Future chemistry teacher, individual approach, research activity, inquiry-based learning, chemical education, laboratory work, scientific competence, teacher training.

INTRODUCTION

The development of research activity among future chemistry teachers is one of the important tasks of higher pedagogical education. A chemistry teacher should not only explain theoretical concepts and demonstrate experiments, but also teach pupils to observe, compare, analyse, formulate hypotheses and draw evidence-based conclusions. Therefore, the research culture of the future teacher becomes a necessary component of professional competence. In the context of rapid scientific and technological development, chemistry education must prepare specialists who are able to work with scientific information, organise experimental activity and apply research methods in teaching practice.

An individual approach is especially important in this process because students differ in their level of preparation, motivation, laboratory experience, cognitive style and professional interests. Uniform tasks and identical learning trajectories do not always allow each student to develop research potential. When educational activity is organised according to individual abilities and needs, students become more engaged, responsible and creative. For future chemistry teachers, this means that research activity should be developed through flexible tasks, differentiated support and personal scientific growth.

The methodological basis of this thesis is formed by the analysis of pedagogical, psychological and methodological literature devoted to individualisation, inquiry-based learning and science teacher education. The system approach was used to interpret research activity as an

integrated process that includes motivation, theoretical preparation, practical experimentation, data analysis and reflection. The competence-based approach made it possible to consider research activity not as an isolated academic skill, but as a component of future professional readiness.

The study also relies on comparative and analytical methods. The comparative method was used to distinguish traditional reproductive learning from individually oriented research training. The analytical method helped to identify the main pedagogical conditions that support the development of research activity in chemistry education. Special attention was paid to laboratory work, independent study, project-based tasks and formative assessment, because these forms of learning directly influence the formation of scientific inquiry skills.

The individual approach creates broad possibilities for developing the research activity of future chemistry teachers because it allows the educational process to be adapted to students' real academic needs. In chemistry education, students may show different levels of understanding in theoretical chemistry, experimental technique, mathematical processing of results and scientific writing. If these differences are ignored, research activity becomes formal and limited to the mechanical performance of laboratory instructions. If they are taken into account, each student can gradually move from simple observation to independent scientific investigation.

One of the main possibilities of the individual approach is the design of personalised research tasks. In traditional laboratory practice, all students often perform the same experiment according to the same instruction. Such work may develop technical accuracy, but it does not always stimulate independent thinking. In an individually oriented environment, students can receive tasks that correspond to their level and interests. For example, one student may focus on qualitative analysis, another on quantitative measurement, while a third may investigate environmental aspects of chemical processes. This differentiation increases motivation and helps students understand the practical significance of chemical research.

The development of research activity also depends on the organisation of inquiry-based laboratory work. Future chemistry teachers should learn to see the experiment not only as a demonstration of known laws, but as a method of discovering, verifying and explaining chemical phenomena. In this process, the teacher educator's role is not limited to giving instructions. The educator guides students in formulating research questions, selecting methods, predicting possible results and interpreting evidence. Individual consultation is essential because each student may face different difficulties during experimental planning or data analysis.

Independent work is another important condition for developing research activity. In the context of an individual approach, independent tasks should not be reduced to reading theoretical material. They should include the search for scientific sources, preparation of short reviews, analysis of experimental data, comparison of methods and development of small research projects. Such tasks form the ability to work with scientific information and develop responsibility for one's own learning results. For future chemistry teachers, this experience is significant because they will later need to guide pupils in independent and project-based learning.

Reflection also plays an important role. A student who performs an experiment but does not analyse the process of inquiry may not fully understand the logic of scientific research.

Reflective tasks help students evaluate the correctness of their methods, identify errors, compare expected and obtained results, and understand the reasons for discrepancies. Individual reflection journals, oral consultations and written feedback create opportunities for deeper understanding. Through reflection, future teachers learn not only chemistry, but also the methodology of teaching scientific thinking.

Assessment in the individual approach should be formative and diagnostic. It must show not only the final result, but also the development of research skills. In chemistry teacher training, it is important to assess how a student formulates a problem, plans an experiment, follows safety rules, processes data, explains results and presents conclusions. Such assessment gives students clear information about their progress and helps the educator choose appropriate support strategies. As a result, evaluation becomes a means of development rather than only control.

The individual approach also supports the formation of professional identity. When students conduct research connected with future teaching practice, they begin to understand themselves as both learners and future educators. They learn how to transform scientific content into educational material, how to explain experimental logic to pupils and how to organise safe and meaningful laboratory activity. Thus, research activity becomes connected with pedagogical activity.

The development of research activity among future chemistry teachers in the context of an individual approach is a necessary condition for improving the quality of professional training. Individualisation allows students' abilities, interests and difficulties to be considered in the organisation of learning. It creates opportunities for personalised research tasks, inquiry-based laboratory work, independent scientific search, reflective analysis and formative assessment.

The thesis shows that the individual approach helps future chemistry teachers develop not only chemical knowledge, but also scientific thinking, methodological awareness and readiness to organise research-oriented learning at school. This approach transforms laboratory and theoretical training into a meaningful process of professional growth. Therefore, the development of research activity through individualisation should be regarded as an important direction in modern chemistry teacher education.

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