



IMPROVING THE TEACHING METHODOLOGY OF THE COURSE “OIL AND GAS FIELD GEOLOGY” ON THE BASIS OF SCIENTIFIC COGNITION METHODS

Buriyev Akbar Yuldoshevich

Independent Researcher, Bukhara State University

Abstract. This article addresses the issue of improving the teaching methodology of the course *Oil and Gas Field Geology* on the basis of scientific cognition methods. The study analyzes an effective instructional model grounded in the integration of the gnoseological approach, methodological foundations, didactic principles, and learning-cognition methods. The possibilities for developing the practical competence of future engineers through the incorporation of such structural components of scientific cognition as the empirical basis, theoretical core, and dialectical outcome into the educational process are substantiated. In addition, the article justifies the need to improve didactic support based on the harmony of scientific and learning-cognition methods within the instructional process. As a result, it is demonstrated that a methodological approach grounded in scientificity, systematicity, consistency, practical orientation, and reflexivity serves as an important factor in strengthening students’ professional training in teaching the course *Oil and Gas Field Geology*.

Keywords: scientific cognition method, gnoseology, methodological approach, didactic support, learning-cognition methods, empirical basis, theoretical core, dialectical outcome, oil and gas field geology, practical competence, engineer training

Introduction. Today, the quality of specialist training in technical higher education institutions depends not only on the content of educational material, but also directly on the methods through which it is taught. In particular, the course *Oil and Gas Field Geology* occupies a special place in the training of personnel for the oil and gas sector. This course develops in future engineers geological thinking, analytical reasoning, an understanding of natural processes, the ability to interpret field structure on a scientific basis, and the competence to make appropriate decisions under industrial conditions.

However, mastering this course through traditional methods, mainly based on reproductive teaching, cannot fully ensure the development of students’ profound scientific thinking, independent conclusion-making ability, and practical preparedness. For this reason, the introduction of scientific cognition methods into the educational process, their integration with learning-cognition activity, and the creation of a didactically grounded methodological system constitute an urgent issue.

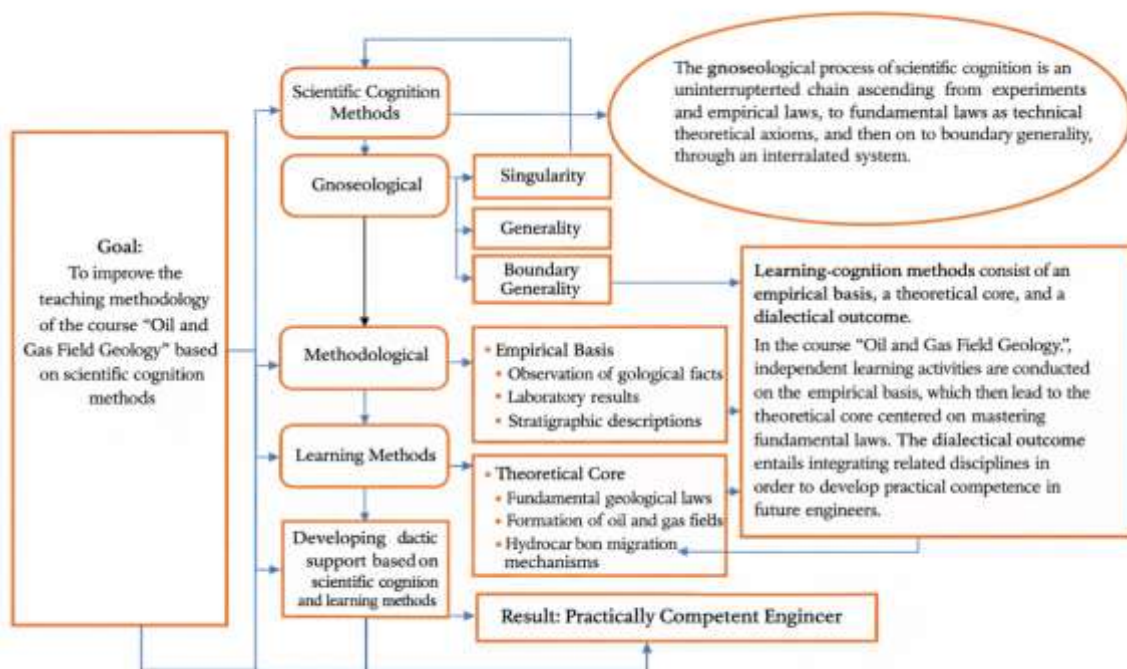
The process of scientific cognition serves to comprehend reality through empirical observation, theoretical generalization, and dialectical analysis. By transferring this process


into education, students become not passive recipients of ready-made knowledge, but active subjects capable of mastering, analyzing, and applying knowledge to new situations. This, in turn, necessitates the renewal of the methodological approach to teaching *Oil and Gas Field Geology*. The purpose of this article is to reveal the theoretical and didactic foundations for improving the teaching methodology of this course on the basis of scientific cognition methods and to substantiate its potential for training practically competent engineers.

Main Part. Scientific cognition methods in the educational process function not only as a means of presenting theoretical concepts, but also as a logical and methodological mechanism for organizing cognitive activity. According to the model presented in Figure 1, the methodological system is centered on the interrelated components of “scientific cognition methods,” “gnoseological,” “methodological,” and “didactic” foundations, which together form an integrated system. These structural elements determine not only the content of teaching, but also its objectives, methods, and outcomes.

From the gnoseological perspective, the process of scientific cognition is regarded as a continuous logical chain that rises from empirical laws based on experiments and data to broader theoretical conclusions, and then to an even wider level of boundary generalization. Such an approach is especially important in the course *Oil and Gas Field Geology*, since students first study concrete facts such as geological observations, layer structure, lithological features, reservoir properties, and tectonic conditions. Subsequently, on the basis of these facts, theoretical generalizations are formed regarding the patterns of field formation, hydrocarbon migration, accumulation, and preservation mechanisms.

From the methodological point of view, the integration of scientific cognition methods with learning-cognition methods is of particular importance in teaching this course. This is because if such research methods as observation, description, comparison, analysis,





modeling, and generalization are adapted and applied within the instructional process, the quality of students' mastery of the course increases significantly. For example, while studying a geological section of a field, it is insufficient merely to use a ready-made diagram; rather, students should be assigned tasks requiring them to independently analyze the relationships among strata, interpret structural maps, and draw conclusions on the basis of geological data. Such tasks stimulate scientific thinking.

Figure 1. Scientific and learning-cognition method (according to S.I. Tolchina).


According to the model presented in Figure 1, cognition through learning is divided into three main structural stages: the empirical basis, the theoretical core, and the dialectical outcome. At the stage of the empirical basis, the student works with geological observations, maps, laboratory results, drilling data, reservoir parameters, and stratigraphic descriptions. At this stage, facts are collected, recorded, described, and initially analyzed. The advantage of this stage lies in the fact that, by working with concrete data, the student perceives the real features of the object and creates a foundation for theoretical knowledge.

At the stage of the theoretical core, the collected empirical data are generalized, and geological laws are revealed on their basis. For example, the conditions of oil and gas formation, source rocks, reservoirs, cap rocks, structural and non-structural traps, as well as hydrocarbon migration and accumulation processes are explained as an interconnected system. Here, the student does not merely memorize a fact, but understands the scientific mechanism underlying it. Precisely for this reason, the theoretical core constitutes the solid foundation of the course content.

At the stage of the dialectical outcome, the student applies the acquired knowledge to new situations, analyzes contradictions and relationships among various factors, and reaches evidence-based conclusions regarding problematic cases. This stage is the most important one in shaping the future engineer's practical competence. This is because real industrial processes in the oil and gas sector are always characterized by uncertainty, multicausality, and complexity. Therefore, the student must not only possess knowledge, but also be able to adapt and apply it under changing conditions.

An important feature of this model is that scientific cognition methods and teaching methods are not viewed as operating in a single direction, but rather as a mutually enriching system. The concepts of singularity, generality, and boundary generality gradually shape the culture of scientific reasoning in students' cognitive activity. First, an individual fact is mastered; then it is connected with a general law; and finally it leads to a broader scientific conception. This transforms the content of education from a simple accumulation of information into a systematized body of scientific knowledge.

Teaching *Oil and Gas Field Geology* precisely on the basis of this approach develops the following qualities in students: scientific analysis of geological objects, the ability to draw substantiated conclusions, the integration of theory and practice, the capacity to find solutions appropriate to industrial situations, professional thinking, and scientific communication.



Thus, the final product of the methodological system is the formation of a practically competent engineer.

Analysis and Results. The analysis shows that the teaching process organized on the basis of scientific cognition methods increases students' interest in the course *Oil and Gas Field Geology*, helps them understand theoretical knowledge more deeply, and prepares them for the fulfillment of practical tasks. In particular, the stage-based system leading from the empirical basis to the theoretical core and then to the dialectical outcome ensures the logical consistency of the instructional process.

Practice demonstrates that classes organized on the basis of geological maps, stratigraphic sections, reservoir descriptions, field models, and exploration and appraisal results develop students' independent thinking. If this process is further enriched with problem-based questions, project tasks, case assignments, and reflective analyses, learning activity becomes even more effective. In this case, cooperation between teacher and student increasingly approximates scientific inquiry.

As a result, the student learns to systematize theoretical knowledge, analyze geological data, identify relationships among different indicators, make scientifically grounded decisions, and carry out professional argumentation. This, in turn, enhances the professional adaptability of future specialists in the oil and gas field under industrial conditions.

Conclusion. Improving the teaching methodology of the course *Oil and Gas Field Geology* on the basis of scientific cognition methods is one of the important directions of modern technical education. This approach contributes to deeper mastery of the course content, the connection of theoretical knowledge with practice, and the development of the practical competence of future engineers.

The harmony of gnoseological, methodological, and didactic foundations makes the educational process scientifically grounded, systematic, and effective. Education organized through the stages of the empirical basis, theoretical core, and dialectical outcome raises students' cognitive activity to an active, independent, and reflective level. Therefore, it is advisable to apply this model widely in teaching the course *Oil and Gas Field Geology*. In the future, its effectiveness may be further enhanced through the development of electronic educational resources, schematic models, interactive assignments, and instructional materials approximated to real industrial situations.

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