EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 2, Issue 5, May 2026
brightmindpublishing.com
ISSN (E): 3061-6972

METHODOLOGICAL APPROACHES TO DEVELOPING NATURAL SCIENCE LITERACY IN GENERAL SECONDARY EDUCATION SCHOOLS

Davletova Hamida Khasan qizi,
Methodologist of the Methodological Service Department,
Researcher at the Abdulla Avloni National Institute of Pedagogical Mastery

Abstract

This study provides a theoretical and scientific analysis of modern methodological approaches to developing natural science literacy in general secondary education schools. The research examines the content and pedagogical significance of competency-based, systems-activity, integrative, inquiry-based, and student-centered approaches. In addition, the study explores the scientific foundations of organizing the educational process based on the HPL (How People Learn) model, substantiating the importance of active, contextual, and socially interactive learning environments in fostering students' natural science literacy.

Keywords: Natural science literacy, methodological approaches, competency-based education, systems-activity approach, integrative education, inquiry-based learning, student-centered education, HPL model, PISA, scientific thinking.

Introduction

In the 21st century, the rapid development of science, technology, and innovations has profoundly influenced all spheres of societal progress, placing new qualitative and content-related demands on the education system. In particular, the teaching of natural sciences in general secondary schools has increasingly focused not only on the acquisition of theoretical knowledge, but also on the development of students' ability to analyze, evaluate, and apply knowledge in real-life situations, which is considered a pressing scientific and pedagogical issue[1].

In contemporary pedagogical research, natural science literacy is interpreted as a set of competencies that enable individuals to understand scientific concepts, think based

[1] Абдуллина О.А. Общепедагогическая подготовка учителя в системе высшего педагогического образования: Для пед. спец. высш. учеб. заведений. – 2-е изд., перераб. и доп. – М.: Просвещение, 1990. – с. 40 - 141

EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 2, Issue 5, May 2026
brightmindpublishing.com
ISSN (E): 3061-6972

on scientific evidence, identify cause-and-effect relationships, and solve social, ecological, and technological problems through scientific approaches[22]. This concept has been defined as a key educational outcome in global conceptual frameworks developed by the OECD and is recognized as the main criterion for assessing students' readiness in science subjects within the PISA international assessment program[3].

Scientific literature emphasizes that countries achieving high results in PISA assessments organize science education not through traditional knowledge transmission, but through competency-based and activity-oriented methodological approaches. This, in turn, scientifically substantiates the close interrelation between the development of natural science literacy and educational methodology[4].

From this perspective, the effective development of natural science literacy in general secondary schools requires, first and foremost, clarifying its methodological foundations, revealing the scientific essence of the approaches used in the educational process, and theoretically substantiating their pedagogical effectiveness. Methodology serves as a fundamental scientific basis that determines the interconnection between the content, forms, methods, and outcomes of the educational process.

In pedagogical science, the development of natural science literacy has been studied within competency-based, systems-activity, integrative (interdisciplinary), inquiry-based, and student-centered approaches[5]. However, analysis of existing research indicates that the issue of integrating these approaches into a unified methodological system has not yet been sufficiently and comprehensively explored.

Therefore, this chapter aims to conduct a scientific-theoretical analysis of methodological approaches to developing natural science literacy in general secondary education schools, to justify their role and significance in the pedagogical process, and to systematize them in accordance with modern educational requirements. This, in turn, strengthens the theoretical foundation of the dissertation research and enhances its scientific novelty and practical relevance.

[2] DeBoer G.E. Scientific literacy: Another look at its historical and contemporary meanings and its relationship to science education reform. *Journal of Research in Science Teaching*, 2000, №37(6), pp. 582–601.
[3] PISA 2018 Assessment and Analytical Framework: Science, Reading, Mathematics. – Paris: OECD Publishing, 2019. – 308 p.
[4] Bybee R.W. Scientific Literacy in Environmental and Health Education. – New York: Springer, 2015. – 214 p.
[5] Хуторской А. В. Ключевые компетенции как компонент личностноориентированной парадигмы образования // Народное образование. - 2003. - № 2. С. 58-64.

EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 2, Issue 5, May 2026
brightmindpublishing.com
ISSN (E): 3061-6972

The content structure of natural science literacy (scientific knowledge, scientific methods of inquiry, scientific thinking, and practical application) demonstrates that lectures or purely reproductive teaching methods alone are not sufficient for its development. International and national pedagogical research emphasizes that a high level of natural science literacy is formed through active cognitive engagement of learners. Therefore, alongside methodological approaches, the correct selection of specific teaching methods is considered an important scientific and pedagogical task. The OECD-developed PISA framework also confirms, based on empirical evidence, the priority of problem-based, inquiry-oriented, and context-based teaching methods in science education.

Modern research in educational theory and practice shows that the effectiveness of the learning process is directly determined by how students acquire, process, and apply knowledge in real-life situations. Therefore, in designing the educational process, there is a growing need to deeply analyze the cognitive and social mechanisms of learning. The HPL (How People Learn) model, developed in response to this need, is recognized as one of the key pedagogical approaches that ensures the scientific organization of the learning process[6].

The HPL model was developed by the National Research Council of the United States under the National Academy of Sciences based on extensive interdisciplinary research and draws on achievements in psychology, pedagogy, and cognitive science. This model interprets learning not as a passive process of receiving information, but as an active, social, and contextual process. Research shows that in effective learning environments, students build new concepts based on their prior knowledge, analyze their own thinking, and apply knowledge in real-life situations.

The scientific significance of the HPL model lies in the fact that it views the educational process not merely as the transmission of content, but as a complex system that develops learners' cognitive activity. Accordingly, the HPL model proposes organizing the learning environment around four interrelated dimensions: learner-centered, knowledge-centered, assessment-centered, and community-centered learning. Scientific literature indicates that the balanced integration of these four components is a necessary condition for developing deep understanding, independent thinking, and stable knowledge acquisition in learners.

[6] National Research Council. How People Learn: Brain, Mind, Experience, and School (Expanded Edition). – Washington, DC: National Academies Press, 2000.

EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 2, Issue 5, May 2026
brightmindpublishing.com
ISSN (E): 3061-6972

Conclusion

The effective development of natural science literacy in general secondary education schools cannot be limited to traditional knowledge-based approaches alone, but requires the integration of modern methodological systems. Analysis shows that competency-based and activity-oriented approaches, particularly learning environments based on the HPL model, play a crucial role in developing students' scientific thinking, problem-solving abilities, and skills of applying knowledge in practical situations. Therefore, ensuring methodological coherence in science education is one of the key factors in improving the quality of education.

References

1. Абдуллина О.А. Общепедагогическая подготовка учителя в системе высшего педагогического образования: Для пед. спец. высш. учеб. заведений. – 2-е изд., перераб. и доп. – М.: Просвещение, 1990. – с. 40 - 141
2. DeBoer G.E. Scientific literacy: Another look at its historical and contemporary meanings and its relationship to science education reform. Journal of Research in Science Teaching, 2000, №37(6), pp. 582–601.
3. PISA 2018 Assessment and Analytical Framework: Science, Reading, Mathematics. – Paris: OECD Publishing, 2019. – 308 p.
4. Bybee R.W. Scientific Literacy in Environmental and Health Education. – New York: Springer, 2015. – 214 p.
5. Хуторской А. В. Ключевые компетенции как компонент личностноориентированной парадигмы образования // Народное образование. - 2003. - № 2. С. 58-64.
6. National Research Council. How People Learn: Brain, Mind, Experience, and School (Expanded Edition). – Washington, DC: National Academies Press, 2000.