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Finland's Experience In Developing Natural-Scientific Literacy Skills

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Abstract: This annotation briefly analyzes Finland's experience in developing students' natural-scientific literacy skills within the education system. In Finnish schools, the teaching process is based on competency-based approaches, interdisciplinary integration, and activity-oriented instruction. Special attention is given to fostering students' independent thinking, critical analysis skills, and environmental awareness.

Keywords: Finnish education system, natural-scientific literacy, competency-based approach, interdisciplinary integration, project-based learning, PISA, experimental learning, critical thinking, scientific thinking, digital education.

In the modern education system, natural-scientific literacy implies not only the acquisition of subject-specific knowledge but also the ability to apply it in real-life situations, draw conclusions based on scientific evidence, and solve practical problems. Therefore, in developed countries, updating the content and methodology of science education is considered a priority for improving natural-scientific literacy.

In foreign educational practices, particularly in the United States, Europe, and Asian countries, the development of scientific literacy is implemented through learner-centered, inquiry-based, and competency-oriented approaches. In these approaches, students are not viewed as passive recipients of ready-made knowledge, but as active constructors of knowledge. Lesson processes emphasize problem formulation, experimentation, data analysis, and scientific discussion.

Research in international education highlights assessment literacy as an essential component of scientific literacy development. Studies on large-scale

assessment tasks show that PISA-type tasks are effective in identifying students' scientific reasoning, problem-solving abilities, and evidence-based decision-making skills. This experience demonstrates that assessment in science education should not only serve as a tool for measuring outcomes but also as a mechanism that supports learning.

In addition, student-centered classroom activities such as project-based learning, inquiry-based learning, and problem-based instruction are considered effective methods for developing scientific literacy in international practice. These approaches increase student engagement, deepen conceptual understanding, and enhance the application of knowledge in practical contexts. In recent years, there has been a growing global trend of integrating natural sciences with global issues to simultaneously develop global competence and scientific literacy. Topics such as climate change, sustainable energy, and environmental challenges are increasingly incorporated into science lessons, enabling students to apply scientific knowledge in real-world contexts. In primary and secondary education, international practices emphasize evidence-based discussion, scientific inquiry, and reflective learning in the formation of conceptual understanding. This process activates students' cognitive engagement and develops core components of scientific literacy—understanding, analysis, and conclusion-making skills. Analysis of international research shows that the effectiveness of developing scientific literacy is directly linked not only to teaching methodologies but also to supportive pedagogical conditions, teachers' professional competence, and assessment approaches. Therefore, international experience requires a comprehensive approach to science education.

Analysis of international experience shows that the development of natural-scientific literacy skills prioritizes student-centered, inquiry-based, and assessment-literate methodological approaches. These approaches serve as an important theoretical and practical foundation for developing methodologies aimed at enhancing natural-scientific literacy, particularly at the 6th-grade level in general secondary education institutions.

Natural-scientific literacy (NSL) is one of the central outcomes of modern general education. It refers to a student's ability to apply scientific knowledge and methods in everyday life situations, draw evidence-based conclusions, make informed decisions, and demonstrate an informed attitude toward scientific and technological processes. Within international assessment programs, particularly PISA, the components of NSL include "explaining scientific phenomena," "interpreting data and evidence to draw scientific conclusions," and "evaluating and designing scientific inquiry." These components justify the need to orient educational content toward competency-based learning. This approach is especially important at the 6th-grade level, as students transition from integrated natural science to more distinct subject areas (biology, geography, physics, chemistry), gradually developing the ability to work with scientific concepts, conduct simple experiments, and plan observations.

In Uzbekistan's educational policy, participation in international assessments, modernization of educational outcomes based on competencies, and strengthening teachers' methodological capacity are also defined as key priorities. This requires a methodological re-examination of approaches aimed at developing natural-scientific literacy skills. Therefore, analyzing international experience serves not only as a "model" but also as an evidence-based foundation for selecting, adapting, and testing methodological solutions appropriate for the 6th-grade level. International practice demonstrates diverse approaches to developing NSL: some systems integrate competency-based assessment frameworks, others adopt phenomenon-based curriculum design, while others emphasize STEM integration, inquiry-based science education (IBSE), and argumentation-based learning.

In analyzing international experience, it is first necessary to clarify measurable indicators of NSL, since methodology is selected according to the specific competencies to be developed. Within the PISA 2025 framework, the concept of scientific literacy has been further expanded to include scientific reasoning processes, working with data and evidence, understanding scientific inquiry design, and interpreting scientific information in digital environments. The key

methodological implication here is that in the 6th grade, scientific literacy should not be limited to memorizing facts; instead, it is more effective to gradually introduce "scientific practices" (questioning, observing, hypothesizing, testing, concluding, and presenting) as a structured learning cycle. Empirical evidence from IBSE studies in European schools confirms this idea: when students are actively engaged in forming scientific questions and using evidence, their conceptual understanding deepens and their motivation increases. This demonstrates that inquiry-based teaching is not merely theoretical but a practically validated instructional approach.

In developed European education systems, the development of natural-scientific literacy is implemented through competency-based approaches. In particular, in the Finnish education system, science education is oriented toward developing students' ability to apply scientific concepts in real-life situations, analyze problems, and draw evidence-based conclusions. Science lessons emphasize inquiry-based learning, experimentation, and interdisciplinary integration. Assessment is organized as a tool that supports learning and is aimed at identifying students' level of scientific thinking and conceptual understanding. In Finland's practice, the integration of ecology and sustainable development into science curricula is considered a key factor in developing natural-scientific literacy.

Finnish Experience. Since 2016, Finland's education system has strengthened phenomenon-based integration within the national curriculum. In this approach, science content is organized around real-life problems and phenomena, enabling students to connect concepts across different disciplines. In Finland, the development of natural-scientific literacy is implemented through the Phenomenon-Based Learning (PBL-FI) model. In this model, natural sciences are not taught as separate topics in a traditional manner but are studied through holistic real-world phenomena. This approach helps students connect scientific knowledge with real-life contexts, understand interdisciplinary relationships, and develop scientific thinking skills. It is particularly effective in developing the NSL component of "explaining scientific phenomena," as

students begin to view phenomena such as climate, energy efficiency, and the water cycle through integrated biological, geographical, and physical perspectives.

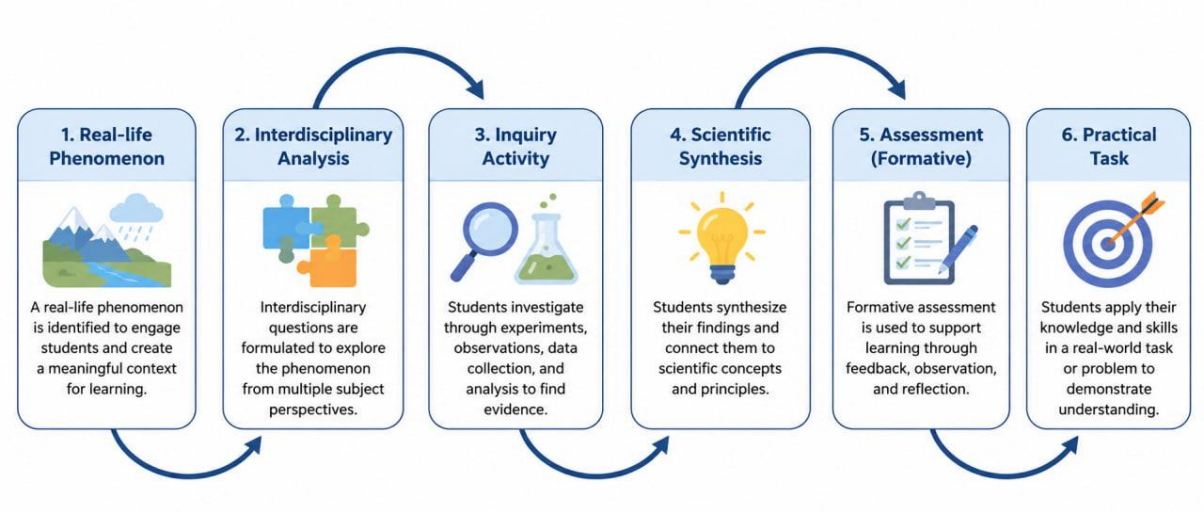
The lesson process organized on the basis of the PBL-FI model is implemented through a clear sequence of stages. In the initial stage of the lesson, a real-life phenomenon is selected for study. For example, a question such as “Why does the water level of rivers rise in spring?” creates a problematic situation for students and fosters their interest in scientific inquiry. In the next stage, interdisciplinary questions are formulated to explain the phenomenon. In this process, concepts from physics (such as the melting and movement of substances), geography (relief and hydrological conditions), and biology (changes in ecosystems) are analyzed in an interconnected manner.

In the third stage, students are engaged in research activities, including conducting experiments, making observations, and analyzing data through tables and diagrams to identify scientific evidence. This activity develops students’ scientific inquiry skills and enables them to acquire knowledge independently. In the final stage of the lesson, the results obtained by students are summarized, and scientific concepts are linked to the real-life phenomenon to draw conclusions.

Within the PBL-FI model, the assessment process is mainly organized in a formative way and is aimed at supporting the learning process of students. Assessment widely uses observation sheets, analysis of students’ activities, and reflective questions such as “What have I understood?” and “What conclusion have I drawn?”. This helps students become aware of their own learning process and deepens their scientific thinking.

Tasks within this model are based on real-life contexts. For example, assignments such as “Describe the water cycle in your local area using a diagram and explain it scientifically” develop students’ ability to apply scientific knowledge in practical situations. As a result, the PBL-FI model helps students understand real-life phenomena through scientific concepts, draw evidence-

based conclusions, and apply knowledge in an integrative way, thereby ensuring the consistent development of natural-scientific literacy.



In 6th-grade lessons, presenting topics not only according to subject divisions but also through a phenomenon-based cycle of "observation–question–investigation–conclusion–presentation" systematically forms natural-scientific literacy. In Finland, formative assessment (assessment for learning) is also strongly implemented, where the teacher continuously monitors students' progress in scientific thinking through rubrics, peer assessment, and reflection journals. This evidence indicates that the development of natural-scientific literacy should not be limited to final testing, but rather should be organized as a set of tools that track the process of competency formation.

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