AMERICAN Journal of Language, Literacy and Learning in STEM Education
Volume 3, Issue 10, 2025 ISSN (E): 2993-2769

Integrating Advanced Foreign Practices in Biology Education (Didactic Solutions for the National System Based on Finland and South Korean Educational Models)

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Abstract. *This article examines the integration of advanced foreign experiences into the national education system in the field of biology teaching. The Finnish and South Korean educational models were comparatively analyzed to identify their effective approaches in teaching biology. In particular, methods such as competency-based learning, STEAM integration, laboratory practice, and the use of digital technologies were proposed for adaptation to the national context. The findings highlight the potential to improve the quality of biology education, foster scientific literacy, and develop learners who are aligned with global scientific trends.*

Key words: *biology education, foreign experience, Finnish model, Korean model.*

Introduction. In recent years, the use of modern pedagogical approaches and advanced foreign experience in teaching biology has become increasingly important. This process requires, first of all, improving the quality of education, forming independent thinking, a creative approach, and practical skills in students. In the "Concept for the Development of the Education System until 2030" (PF-5847, 2019), adopted in the Republic of Uzbekistan, the adaptation of international experience to the national system is defined as a priority task of educational reforms.

International practice shows that the integration of advanced foreign experience into the education system, along with increasing students' interest in subjects, also contributes to their involvement in creative and research activities. For example, when analyzing the effectiveness of the Finnish education model, Sahlberg emphasizes that its focus is on developing the student's personality, encouraging independent and critical thinking, as well as creating individual learning trajectories. At the same time, Lee and Kim, studying the South Korean education system, note that high technologies, digital platforms, and competency-based assessment mechanisms play an important role in teaching biology.

Innovative approaches in biology education, including STEAM integration, project-based learning, and experimental laboratory work, are widely used globally[3.4]. Through these methods, students not only acquire theoretical knowledge, but also have the opportunity to apply it in solving real-life problems.

The process of implementing these approaches in the national education system is also being carried out in stages. Uzbek researchers, for example, Kodirova and Abdullaeva, in their works developed didactic foundations for adapting foreign experience to the national educational process and substantiated the effectiveness of reflexive and competency-based methods in teaching biology.

Thus, the educational models of Finland and South Korea are recognized as effective examples in the formation of independent thinking, a creative approach, and practical skills in students in biology.

This article is dedicated to integrating these advanced foreign experiences into the national biology education system and developing didactic solutions based on them.

Methods:

In this study, several methodological approaches were used to determine the possibilities of adapting advanced foreign experience in the development of biology education to the national system. The methodological basis of the research was based on the methods of comparative-pedagogical analysis, content analysis, and pedagogical modeling.

In the method of comparative analysis, the education systems of Finland and South Korea were studied in depth, and their approaches to teaching biology were analyzed in comparison with the national system. As scholars of comparative pedagogy note, by comparing educational systems, it is possible to develop innovative solutions adapted to national conditions[1]. Comparative analysis in biology education made it possible to determine the level of integration of environmental competencies, laboratory activities, and practical experience in the teaching of natural sciences.

In the content analysis method, state documents, international ratings, scientific articles, and advanced foreign methodological literature related to biology were studied. As Neuendorf noted, content analysis contributes to the systematic study of scientific and pedagogical processes, the division of information into thematic categories, and the drawing of conceptual conclusions. With the help of this method, the basic principles of teaching biology in the curricula of Finland and South Korea (competency-based approach, teaching natural science based on interdisciplinary integration, project-based teaching) were systematized.

Using the method of pedagogical modeling, didactic solutions were developed for adaptation to the national education system. Pedagogical modeling is the process of creating a conceptual model for the theoretical justification of the educational process and its implementation in practice [12]. The study modeled the features of biology education, that is, the experimental study of life processes, tasks aimed at solving environmental problems, as well as the possibilities of developing students' reflexive and critical thinking.

Table of Methods in Biology Education:

Method	Description	Scientists' views	Applications in Biology Education
Comparative analysis	The educational systems of Finland and South Korea were studied, and approaches in biology were compared with the national system. Through comparative pedagogy, it is possible to develop innovative solutions adapted to national conditions (Bray, Adamson & Mason, 2014).	Comparative pedagogy is effective in creating innovative solutions for national education (Bray, Adamson & Mason, 2014).	Formation of environmental competencies, integration of laboratory work and practical experience.
Content analysis	State documents, international ratings, scientific articles, and methodological literature on biology were analyzed. Content analysis helps to systematically study scientific and pedagogical processes and draw conceptual conclusions (Neuendorf, 2017).	Content analysis is important for the systematic analysis of educational processes and drawing conclusions (Neuendorf, 2017).	Systematization of the principles of biology programs: competency-based approach, interdisciplinary integration, project-based learning.
Pedagogical modeling	Didactic solutions were developed for the national system. Pedagogical modeling is the process of creating a model for the theoretical justification of the educational process and its implementation in practice (Seel, 2012). Features of biology education: experimental study of life processes,	Pedagogical modeling helps to create a conceptual model that increases the effectiveness of education (Seel, 2012).	Development of reflexive and critical thinking, solving environmental problems and applying experimental tasks.

	ecological tasks, development of reflective and critical thinking.		

Also, Holbrook and Rannikmae (2009) emphasize the importance of forming scientific literacy in the methodology of biology education, while Bybee emphasizes the development of students' creative competencies through the application of the STEAM approach in biology. These views served as a theoretical and methodological basis for the selection of methods used in the study and their adaptation to national education.

Results

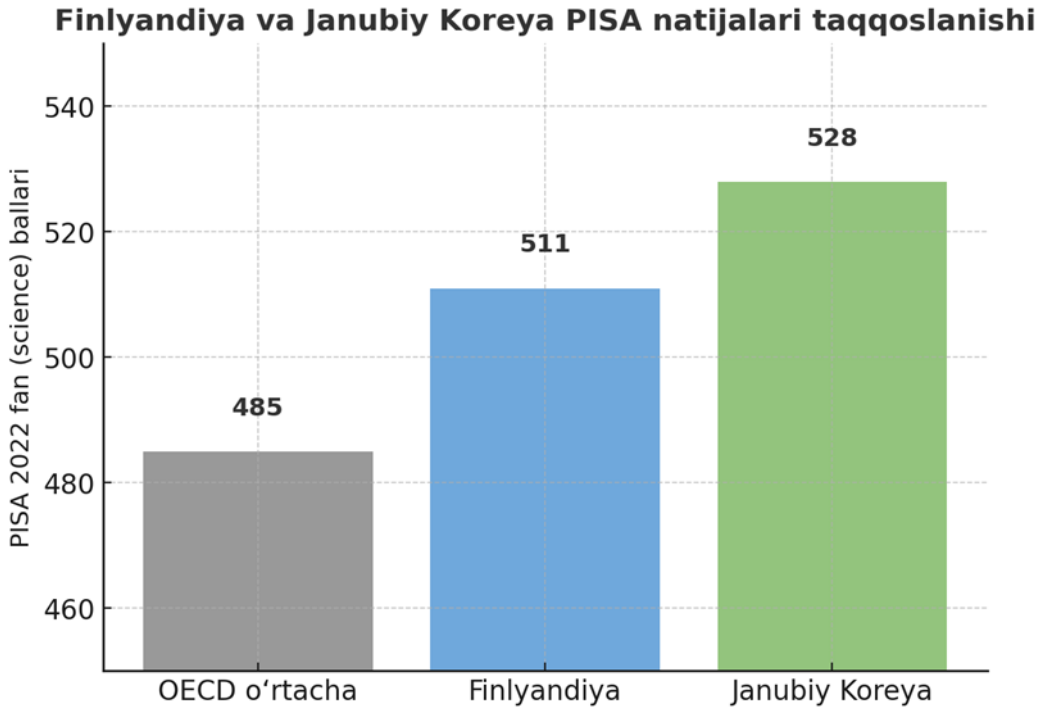
The results of the analysis show that advanced foreign educational models have their own approaches to teaching biology, which are important in creating effective didactic foundations for the national education system. In particular, the fact that Finland and South Korea achieved high results in international assessments of students' indicators in science, including biology/natural sciences, increases the reliability of the results.

The Finnish educational model is based on the principle of centering the student in biology education. In this model, the priority is the direct observation of natural processes by students, the assimilation of biological knowledge on an experimental basis through field practice and laboratory work. According to the OECD PISA 2022 results, Finland scored an average of 511 points in science among 15-year-old students, which is significantly higher than the OECD average (485 points). This indicates that the level of study of natural sciences in Finnish schools exceeds the international norm. According to Sahlberg (2015), Finnish education places great emphasis on "scientific literacy" and aims to develop students' abilities to understand, analyze biological phenomena and apply them to life situations.

The South Korean education model is distinguished by its enrichment with high technologies. In this system, digital educational platforms, virtual laboratories, and simulations are widely used in teaching biology. According to the results of PISA 2022, South Korean students scored an average of 528 points in science, which is significantly higher than the OECD average (485 points). According to Lee & Kim (2020), the "competency-based assessment" system plays an important role in the educational process in South Korea; it assumes that not only theoretical knowledge of students is assessed, but also their effectiveness in practical activities. Also, in the Korean model, biology education is integrated with tasks aimed at solving modern environmental problems and is aimed at developing "ecological competence" and "life skills" in students.

A common feature of both models is that they see biology education not only as a means of imparting scientific knowledge, but also as a process of personal development and expansion of the student's scientific worldview. These experiments served as the basis for the development of the following didactic solutions in biology education in Uzbekistan:

1. Equipping biology laboratories with modern technologies and expanding experimental activities. This strengthens students' skills in applying scientific methodology and drawing conclusions based on observation (Holbrook & Rannikmae, 2009).
2. Ensuring interdisciplinary integration by applying the STEAM (Science, Technology, Engineering, Arts, Mathematics) approach to biology. According to Bybee, the STEAM approach enriches biology education with creativity and innovative thinking.
3. Implementation of a competency-based assessment system, in which not only theoretical knowledge is assessed, but also the competencies of "scientific thinking," "creative approach," and "problem solving."
4. Wide use of project-based assignments that involve students in independent research. This serves to orient students towards scientific research and the formation of a reflexive approach in the study of biology.



Thus, the experience of Finland and South Korea has enriched biology education with innovative methods and opened up new didactic opportunities that can be effectively applied in the national education system. In particular, in cases where PISA results are supported by high indicators, proposals for updating biology education will have a scientific basis.

Discussion

The research results show that the educational models of Finland and South Korea, along with deepening students' knowledge in biology, have an effective influence on the development of critical thinking and reflexive thinking. These aspects are closely related to the specific features of biology - that is, the observation of natural processes, conducting experiments, the complexity of biological systems, and the analysis of environmental problems.

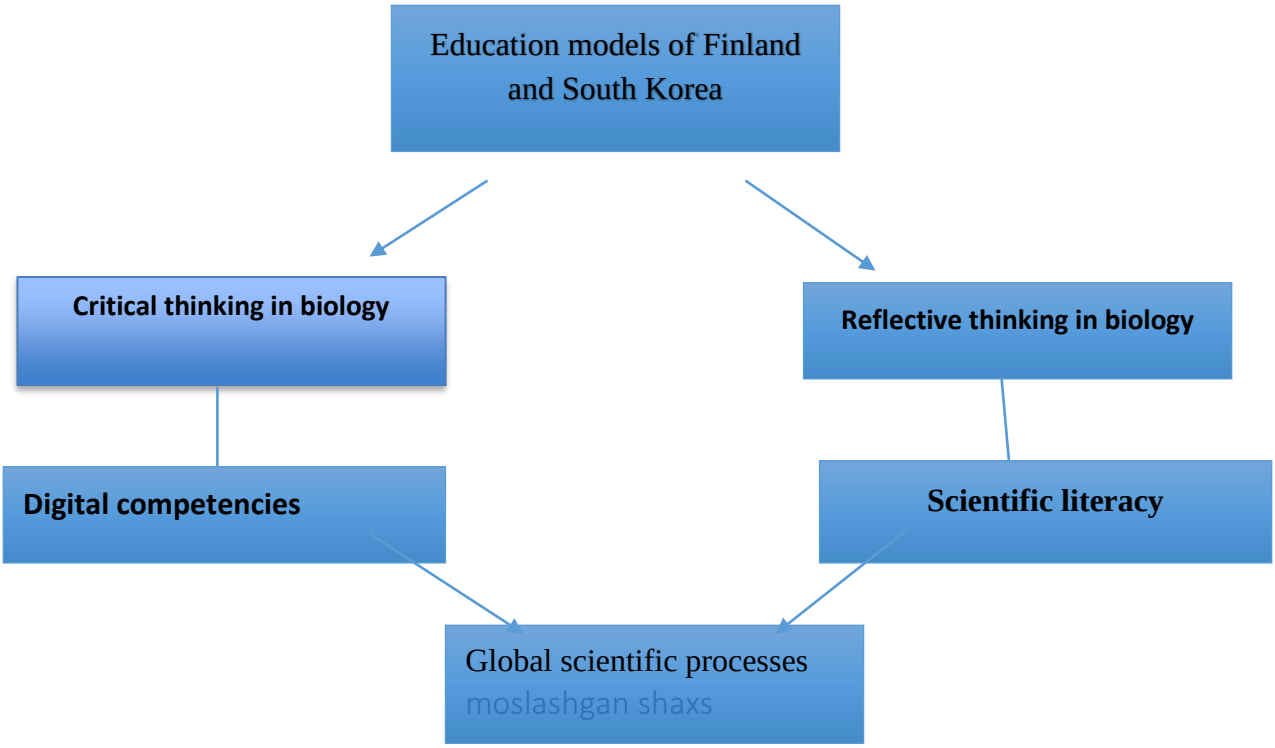
According to the theory of reflective pedagogy (Schön, 1983; Dewey, 1933), it is crucial for biology education that students gain a deeper understanding by analyzing and evaluating their experiences during the learning process. For example, in biology labs, the student not only receives the result of the experiment, but also analyzes the cause of the result, searches for alternatives, and develops a reflexive approach in this process.[13.14]

Critical thinking is an integral part of scientific methodology in biology education. Paul & Elder defines critical thinking as "the process of analyzing, evaluating data, and drawing logical conclusions." This approach is important in biology, for example, when analyzing genetic problems, finding solutions to environmental problems, or assessing biological factors related to healthcare.

Also, the formation of digital competencies occupies a special place in biology education. As Voogt & Roblin emphasizes, the effective use of digital tools in modern education is a key condition for the development of 21st-century skills in students. The use of virtual laboratories, simulations, and online platforms in South Korean education serves not only to consolidate knowledge in the study of biology, but also to develop students' research competencies.

Integration of advanced foreign experience into the national education system also allows for the formation of the concept of scientific literacy (scientific literacy) in biology. According to Holbrook & Rannikmae, scientific literacy develops students' "ability to apply scientific concepts in everyday life situations" when studying biology. This is an important factor in the upbringing of an individual adapted to global scientific processes.

Thus, by applying the experience of Finland and South Korea in national biology education, there is an opportunity to improve the quality of education, develop reflective and critical thinking, form digital competencies, and educate the student's personality, adapted to global scientific trends.



Conclusion

Based on the research, it can be concluded that the integration of advanced foreign experience into biology education is an important tool for increasing the effectiveness of the national education system. A comparative analysis of the experience of Finland and South Korea made it possible to identify their priority approaches in biology education and to develop didactic solutions adapted to the national system.

As Sahlberg emphasized, the success of Finnish education lies in the development of students as individuals, stimulating their independent thinking, and creating broad opportunities for learning based on experience. Similarly, Lee & Kim highlighted competency-based assessment, digital platforms, and the use of high technologies as strengths of the South Korean model.

The didactic solutions developed for national biology education - equipping laboratories with modern technologies, implementing STEAM integration, implementing competency-based assessment, and supporting students' independent research activities - serve not only to provide knowledge, but also to provide students with scientific literacy and 21st-century skills. Holbrook & Rannikmae recognizes scientific literacy as the most effective concept for connecting biology with everyday life problems.

Also, according to the theory of reflexive learning (Schön, 1983; Dewey, 1933), the formation in students of the competence of knowledge analysis and self-assessment through experimental activity increases the didactic effectiveness of biology education. This approach allows not only theoretical knowledge of biological processes, but also their application in the ecological and social context.

Thus, the recommendations developed on the basis of the educational models of Finland and South Korea allow for the widespread introduction of innovative pedagogical approaches in national biology education, the development of critical thinking, a reflexive approach, and digital competencies in students. This, in turn, serves to educate an environmentally responsible person, adapted to global scientific processes.

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