Original Article
IRSTI 14.35.07 https://doi.org/10.51889/2960-1649.2026.66.1.013

MUKHAMETZYANOVA FLERA[1], DZHUMAGAZIYEVA ASSEL[2], ISKAKOVA KURALAY[3], DLIMBETOVA GAINI[2]*

[1]Kazan Federal University (Kazan, Russian Federation)
[2]L.N. Gumilyov Eurasian National University (Astana, Kazakhstan)
[3]Astana International University (Astana, Kazakhstan)

[*]Address of correspondence: Dzhumagaziyeva Assel, L.N. Gumilyov Eurasian National University, 2 Satpayev Street, 010008, Astana, Kazakhstan, https://orcid.org/0009-0008-4823-2499, E-mail address: Dasel_84@mail.ru /Tel. +7 747 605 4617

Developing Environmental Thinking in Teacher College Students Through Intellectual Project-Based Activity

Abstract

Introduction. The development of environmental thinking is an important objective of contemporary teacher education, driven by global environmental challenges and the need for environmentally responsible professional behavior. In teacher colleges, however, environmental education often remains fragmented and insufficiently practice-oriented, which limits students' readiness for real-life environmental decision-making. *Methodology and Methods.* The study employed a mixed-methods design and was conducted as a pedagogical experiment during the 2024–2025 academic year. The research involved students of teacher training colleges. Data were collected through questionnaires, situational tasks, and expert assessment of project activities aimed at diagnosing cognitive, value-motivational, and behavioral-reflective components of environmental thinking. Quantitative data were processed using descriptive statistics and comparative analysis. *Results.* The findings indicate a positive dynamic in the development of environmental thinking following the implementation of intellectual project-based learning. A decrease in the proportion of students with a low level of environmental thinking and an increase in medium and high levels were observed. The most significant changes occurred in the behavioral-reflective component, demonstrating a shift from declarative knowledge to environmentally responsible behavior. Interrelations between the structural components of environmental thinking were also identified. *Scientific novelty.* The study substantiates the effectiveness of intellectual project-based activity as an integrated pedagogical tool for developing environmental thinking in teacher colleges. *Practical significance.* The results can be used in teacher training colleges to improve environmental education through the integration of project-based activities into existing curricula.

Keywords: pedagogical technologies; environmental thinking; environmental education; project-based learning; intellectual and project-based activity; secondary vocational education.

Introduction. In the context of contemporary environmental challenges, the formation of environmental thinking is increasingly recognized as a key objective of modern education. Climate change, ecosystem degradation, and growing anthropogenic pressure on natural resources require not only technological solutions, but also the development of stable value orientations and responsible patterns of behavior. In this regard, teacher education plays a particularly important role, as future teachers act as mediators of environmental values and influence students' attitudes and behavioral models.

In pedagogical and psychological research, environmental thinking is commonly understood as an integrative construct that combines environmental knowledge, value-based orientations and readiness for environmentally responsible action. Numerous studies emphasize that the possession of environmental knowledge alone does not automatically lead to environmentally responsible behavior. Researchers point to a persistent gap between cognitive awareness and practical action, which indicates the limitations of traditional approaches to environmental education (Babikov & Maladaeva, 2022).

This problem is especially evident in the system of vocational and teacher education. Empirical studies demonstrate that environmental training at this level is often fragmented and primarily focused on the transmission of theoretical information. Such an approach provides insufficient conditions for the development of reflective skills and behavioral components of environmental thinking, as a result of which environmental issues are perceived by students as abstract and weakly connected with their future professional activity (Titova, 2022; Smirnova, 2023).

One of the promising ways to overcome these limitations is project-based learning. Research shows that project-oriented educational environments enable the integration of theoretical knowledge with practical experience, stimulate active learning and foster responsibility for decision-making. Within environmental education, project-based activities allow students to engage with real ecological problems, analyze their causes and consequences, and propose viable solutions grounded in professional practice (Baigunakova et al., 2025).

Studies conducted in higher and vocational education contexts indicate that project-based learning contributes to the development of key competencies, including critical thinking, initiative and environmental responsibility (Mukhametkairov et al., 2025). At the same time, despite the growing theoretical interest in this approach, empirical studies addressing the systematic implementation of project-based learning in teacher training colleges remain limited. In many cases, project activities are applied episodically and do not form a coherent pedagogical system (Kharina et al., 2022; Urunova et al., 2020).

This situation reveals a contradiction between the acknowledged pedagogical potential of project-based learning and its insufficient integration into vocational teacher education practice. Addressing this contradiction requires empirical verification of educational models that combine intellectual engagement with practical, environmentally oriented activities.

The purpose of the present study is to provide theoretical justification and empirical verification of the effectiveness of intellectual and project-based learning as a means of developing environmental thinking among students of teacher training colleges. The objectives of the study include analyzing contemporary approaches to environmental thinking formation, identifying the pedagogical potential of project-based learning, defining criteria and indicators for assessing environmental thinking, and evaluating the effectiveness of the proposed Programme through a pedagogical experiment.

The object of the study is the process of professional training of students in teacher training colleges.

The subject of the study is the development of environmental thinking among students of teacher training colleges under conditions of intellectual and project-based activity.

Given the need not only to diagnose the level of students' environmental knowledge but also to identify the mechanisms that enable the transition from awareness of environmental problems to environmentally responsible behavior, an experimental research design was adopted. This design was focused on analyzing the structural components of environmental thinking and the nature of their interaction, which determined the choice of research methods and procedures.

This study seeks to examine whether engaging teacher college students in intellectually oriented project-based activities contributes to the development of their environmental thinking, and to assess the extent of this impact through experimental validation.

Materials and Methods. The empirical study was conducted during the 2024–2025 academic year at the teacher training colleges in the West Kazakhstan region. The research design was based on a sequential pedagogical experiment and included three interrelated stages: diagnostic, formative, and control. This design made it possible to trace the dynamics of changes in students' environmental thinking and to assess the impact of the implemented pedagogical intervention.

The experiment was conducted without a control group. The absence of a control group was due to organizational constraints

of the educational process. The reliability of the obtained results was ensured through the comparison of data collected at the diagnostic and control stages, as well as through the application of statistical methods of analysis. This approach corresponds to the objectives of the present study and reflects common practices in pedagogical research conducted under real educational conditions.

The formative Programme was integrated into the content of the disciplines Pedagogy, Methods of Teaching Natural Sciences, and Teaching Practice. The experimental work was carried out at the Zh. Dosmukhamedov Higher Pedagogical College (Uralsk) during the spring semester. Students' project activities were organized during the second and third weeks of teaching practice in partner schools. This arrangement provided opportunities to test project ideas in real educational settings and enabled the integration of theoretical knowledge with practical experience.

Participants. A total of 158 students aged 16–20 years, enrolled in pedagogical specializations, participated in the study. A full-population sampling strategy was applied, which ensured the inclusion of all students from the selected academic groups and increased the internal validity of the findings. Most participants were first- and second-year students, which allowed the analysis of environmental thinking formation at the early stages of professional training. The sample was relatively homogeneous in terms of age and educational characteristics.

The methodological framework of the study was based on the system-activity approach and the project-oriented approach. The system-activity approach made it possible to conceptualize the learning process as a dynamic interaction between students, the educational environment, and socially significant tasks. This approach is particularly relevant for environmental education, as it focuses on the integrated development of cognitive, value-based, and behavioral components. The project-oriented approach was aimed at solving practice-oriented problems and contributed to the development of reflective thinking and professional responsibility among students.

Within the framework of the present study, environmental thinking was conceptualized as a multidimensional construct comprising three interrelated components. The cognitive component reflected the level of understanding of environmental problems, the causes of ecological crises, and the principles of sustainable development. The value-motivational component characterized attitudes towards nature, the level of environmental responsibility, and readiness to participate in environmentally oriented activities. The behavioral-reflective component indicated readiness for environmentally responsible actions and the ability to analyze and evaluate one's own behavior.

Data Collection Tools. A set of methods was applied to diagnose the level of environmental thinking. The cognitive component was assessed using a structured questionnaire consisting of 25 items aimed at identifying students' knowledge of key environmental concepts and issues. The internal consistency of the questionnaire was confirmed by a reliability coefficient of 0.81, indicating a high level of instrument reliability.

The value-motivational component was examined using a modified environmental attitudes scale, which made it possible to assess the level of ecological concern, the sense of personal responsibility, and motivation to participate in environmental initiatives. The behavioral-reflective component was diagnosed through situational tasks requiring the analysis of environmental problem scenarios and the development of practical solutions. In addition, expert assessment of students' project work was conducted based on criteria such as relevance, feasibility, and creativity.

Based on the analysis of theoretical sources and empirical data, three levels of environmental thinking were identified: low, medium, and high. The low level was characterized by fragmented ecological knowledge, weakly expressed value orientations, and a passive attitude towards environmental problems. The medium level reflected the presence of basic environmental knowledge and generally positive attitudes towards environmental protection, while behavioral manifestations remained unstable. The high level was defined by a systemic under-

standing of environmental problems, internalized ecological values, and readiness for sustainable, environmentally responsible behavior.

At the formative stage, students were involved in an intellectual and project-based Programme focused on solving real environmental problems relevant to educational institutions and local communities. Project topics included waste management in educational organizations, improving energy efficiency, and developing environmental awareness activities for schoolchildren. Project work was accompanied by reflective discussions and peer assessment, which contributed to the development of analytical and reflective skills.

Data Analysis Technique. Since environmental thinking was conceptualized in the study as an integrative construct, an important task was not only to identify changes in each component but also to analyze the nature of their interrelations. This consideration determined the choice of appropriate statistical data processing methods. Quantitative data analysis was carried out using descriptive statistics and Student's *t*-test. The level of statistical significance was set at $p < 0.05$, which allowed the assessment of the reliability of differences between the results obtained at the diagnostic and control stages of the study.

To achieve a deeper analysis of the relationships between the structural components of environmental thinking, a correlation analysis was conducted. This analysis made it possible to determine the degree of coherence between the cognitive, value-motivational, and behavioral-reflective components and to identify the nature of their mutual influence.

Pearson's correlation coefficient was used for correlation calculations, as the distribution of indicators across the main variables met the criteria of normality. The analysis was performed using data obtained at the control stage of the experiment, which allowed the identification of stable relationships formed during the implementation of the intellectual and project-based Programme. the level of statistical significance was set at $p < 0.05$.

Results. At the diagnostic stage of the study, the initial level of environmental thinking among students of teacher training colleges was determined in order to identify baseline characteristics and existing difficulties in the formation of environmentally responsible attitudes and behavior. The obtained results reflect the state of environmental thinking before the implementation of the intellectual and project-based Programme.

The initial distribution of environmental thinking levels in Table 1 presents the distribution of students according to the identified levels of environmental thinking at the diagnostic stage.

Table 1

Initial distribution of environmental thinking levels (n=158)

Level	Number of students	Percentage (%)
Low	76	48
Medium	58	37
High	24	15

The obtained data indicate that the majority of students were classified at low and medium levels of environmental thinking. Nearly half of the respondents demonstrated a low level, characterized by fragmented ecological knowledge, a weak understanding of cause-and-effect relationships in environmental processes, and a limited ability to apply theoretical knowledge in practical situations. Students at this level typically rely on isolated facts and descriptive judgments when analyzing environmental problems, which hinders the development of reasoned and sustainable solutions.

Students classified at the medium level demonstrated a more stable understanding of basic environmental concepts and, in general, a positive attitude towards environmental

protection. However, their environmentally responsible behavior remained situational in nature and largely dependent on external regulation. When confronted with complex or unfamiliar environmental situations, these students experienced difficulties in independently analyzing problems and substantiating their decisions.

Only a relatively small proportion of respondents exhibited characteristics corresponding to a high level of environmental thinking. These students demonstrated systemic thinking, the ability to consider environmental problems from multiple perspectives, and the presence of internalized ecological values. They were more confident in applying knowledge to practice-oriented tasks and in proposing feasible solutions. Nevertheless, the limited number of such students at the initial stage indicates an insufficient level of environmental thinking development among the majority of participants at the beginning of their professional training (Malyashova & Gadelshina, 2025; Dlimbetova, 2020).

Distribution of environmental thinking levels after the implementation of the Programme.

Following the implementation of the intellectual and project-based Programme, repeated diagnostics were conducted at the control stage in order to assess changes in the level of environmental thinking. The results are presented in Table 2.

Table 2

Distribution of environmental thinking levels after the intervention (n=158)

Level	Number of students	Percentage (%)
Low	19	12
Medium	73	46
High	66	42

The data demonstrate substantial changes in the distribution of students across environmental thinking levels. The proportion of students with a low level decreased from 48% to 12%, while the number of students with medium and high levels increased significantly. The most pronounced growth was observed in the high-level group, whose size increased almost threefold after participation in the Programme.

Comparative dynamics of environmental thinking levels. In order to identify the dynamics of changes, a comparative analysis of the results. obtained at the diagnostic and control stages was conducted.

Table 3

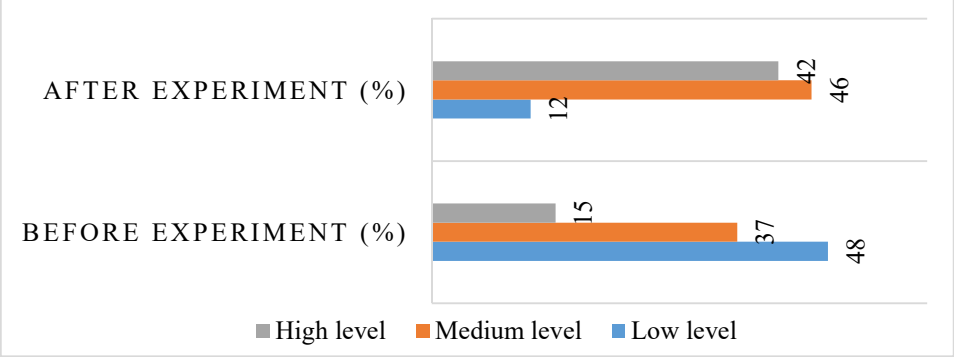
Comparative dynamics of environmental thinking levels (%)

Level	Diagnostic stage	Control stage
Low	48	12
Medium	37	46
High	15	42

The comparative data indicate a clear redistribution of students across environmental thinking levels. The recorded quantitative changes reflect not only an increase in environmental knowledge but also qualitative shifts in approaches to analyzing environmental problems. After the intervention, students more frequently considered environmental issues in a broader context, taking into account social, economic, and educational factors (Babikov & Maladaeva, 2022; Malyashova & Gadelshina, 2025). Their responses became more structured, and their argumentation more logically grounded rather than fragmentary. For a more visual representation of the dynamics of environmental thinking levels, the comparative results are presented in Figure 1.

Figure 1

Dynamics of environmental thinking levels before and after the experiment



The figure illustrates a consistent decrease in the proportion of students with a low level of environmental thinking alongside a simultaneous increase in medium and high levels, which indicates a systemic effect of the implemented Programme.

Changes in structural components of environmental thinking. To clarify the nature of the observed changes, an analysis of shifts in the structural components of environmental thinking was conducted.

Table 4

Changes in structural components of environmental thinking

Component	Diagnostic stage	Control stage
Cognitive	Fragmented knowledge of environmental issues	Systemic understanding of environmental problems
Value-motivational	External motivation, situational attitudes	Internalized ecological values
Behavioral-reflective	Low readiness for action	Stable, environmentally responsible behavior

The results indicate that the most significant changes occurred not only at the cognitive level but also within the value-motivational and behavioral-reflective components. Whereas at the diagnostic stage, environmental thinking was predominantly declarative in nature, after the intervention, a more integrated structure was identified, combining knowledge, values, and behavior.

Correlation analysis of environmental thinking components. An analysis of changes in individual components of environmental thinking does not fully explain the nature of the observed shifts without considering their interdependence. Therefore, at the next stage, a correlation analysis was conducted to identify the degree of coherence between the cognitive, value-motivational, and behavioral-reflective components.

The results revealed statistically significant positive correlations among all components. A strong positive relationship was identified between the cognitive and value-motivational components ($r=0.62$; $p<0.01$), indicating a close association between the depth of understanding of environmental problems and the formation of stable ecological values. A significant correlation was also found between the cognitive and behavioral-reflective components ($r=0.57$; $p<0.01$), suggesting that well-developed environmental knowledge facilitates the transition from understanding to practical action.

The strongest relationship was observed between the value-motivational and behavioral-reflective components ($r=0.69$; $p<0.01$), which confirms the key role of value orientations in shaping environmentally responsible behavior.

Table 5

Correlations between components of environmental thinking (n=158)

Components	r	p
Cognitive – Value-motivational	0.62	< 0.01
Cognitive – Behavioral-reflective	0.57	< 0.01
Value-motivational – Behavioral-reflective	0.69	< 0.01

The correlation analysis explains the dynamics recorded in Tables 1–3. The growth of the value-motivational component acted as a mediating factor in subsequent changes in students' behavioral practices, which confirms the effectiveness of intellectual and project-based activity as a pedagogical means of developing environmentally responsible behavior among future teachers.

Discussion. The results obtained in this study allow for a deeper interpretation of the mechanisms underlying the development of environmental thinking among students of teacher training colleges. The predominance of low and medium levels of environmental thinking at the diagnostic stage confirms the existence of a well-documented gap between environmental awareness and environmentally responsible behavior, which has been widely discussed in contemporary research on environmental education (Titova, 2022). This finding indicates that, at the initial stage of professional training, students' ecological knowledge and attitudes remain insufficiently integrated into stable behavioral patterns.

The substantial redistribution of students across environmental thinking levels observed after the implementation of the intellectual and project-based Programme suggests that project-oriented learning facilitates qualitative transformations rather than merely increasing the volume of acquired knowledge. Unlike traditional instructional approaches, which often focus on the transmission of factual information, project-based learning creates conditions for engagement with real-world environmental issues. Similar effects have been reported in previous studies emphasizing the role of project-based learning in integrating cognitive, value-based, and behavioral components of education (Smirnova, 2023; Baigunakova et al., 2025).

Of particular importance is the significant increase in the proportion of students demonstrating a high level of environmental thinking. This shift reflects a transition from a situational and externally regulated understanding of environmental issues to more systemic reasoning and stable behavioral orientations. Such a transition is consistent with findings reported in earlier studies on the effectiveness of project-oriented learning in environmental education, which highlight its potential to foster the internalization of ecological values and long-term behavioral change (Mukhametkairov et al., 2025; Urunova et al., 2020).

The observed changes can also be interpreted through the lens of student segmentation according to environmental thinking profiles. The redistribution of students across levels suggests that individuals initially characterized by passive or externally motivated attitudes gradually moved towards profiles defined by responsibility, openness, and social orientation. This transition supports the interpretation of environmental thinking as a dynamic and structurally integrated phenomenon rather than a static set of isolated characteristics.

The correlation analysis further clarifies the mechanisms behind the identified changes. Statistically significant positive relationships between the cognitive, value-motivational, and behavioral-reflective components indicate that these dimensions develop in close interdependence. In particular, the strong correlation between the value-motivational and behavioral-reflective components explains why behavioral changes became especially pronounced after the intervention. As students' ecological values became internalized, they increasingly translated knowledge and attitudes into environmentally responsible actions.

This finding confirms the integrative effect of intellectual and project-based activities and explains why improvements were not limited to isolated indicators but affected the overall structure of environmental thinking.

From a practical perspective, the results demonstrate that the structured integration of intellectual and project-based learning into teacher education programmes contributes to the formation of environmentally responsible behavior. Importantly, the findings indicate that such integration is feasible within existing curricula and does not require substantial organizational or structural changes. This makes the proposed approach particularly relevant for teacher training colleges, where curricular flexibility is often limited. The results therefore highlight the potential of project-oriented pedagogical technologies to strengthen environmental education and support sustainable development within the system of vocational teacher education (Balycheva, 2020; Kuzmina & Bibikova, 2022).

Conclusion. This study substantiates the effectiveness of intellectual and project-based activities in developing environmental thinking among teacher training college students. It empirically confirms that integrating practice-oriented projects into pedagogical disciplines leads to measurable positive changes in cognitive, value-motivational, and behavioral-reflective components of environmental thinking.

The research identifies the structural composition of environmental thinking as an integrated construct and demonstrates statistically significant relationships between its components. It establishes that value-motivational factors play a key role in transforming environmental knowledge into environmentally responsible behavior. The scientific contribution of the study lies in providing empirical evidence of the applicability and effectiveness of intellectual project-based learning within secondary vocational pedagogical education and in defining pedagogical conditions that ensure its successful implementation in teacher training colleges.

References

Babikov, V. A., & Maladaeva, O. K. (2022). Formation of environmental thinking of students when studying technological disciplines at a pedagogical university *Vestnik Buryatskogo Gosudarstvennogo Universiteta. Obrazovanie. Lichnost'. Obshchestvo*, (3–4), 8–13. https://doi.org/10.18101/2307-3330-2022-3-4-8-13

Baigunakova, A. S., Dzholdasbekova, B. U., & Yanzhun, G. (2025). Project-based activity as a basis for partnership interaction between teacher and student in the educational process, *Bulletin of Abai Kazakh National Pedagogical University. Pedagogical Sciences Series, 2*(86), 266–276. https://doi.org/10.51889/2959-5762.2025.86.2.024

Balycheva, E. E. (2020). Project-based activity in environmental education of preschool children, *Pedagogical Mastery,* (4), 15–19.

Dlimbetova, G. K. (2020). Value-based approaches in ecological competence formation in higher education. *Sustainability in Education, 12*(4), 201–215.

Kharina, G. V., Miroshnikova, E. G., Alyoshina, L. V., & Inzhevatova, O. V. (2022). On the project method of forming key competencies of university students, Higher Education Today, (9), 65–69. https://hetoday.ru/

Kuzmina, V. F., & Bibikova, N. V. (2022). Development of creative abilities of college students in project-based activity, *Modern High Technologies*, (6), 81–85.

Malyashova, A. Yu., & Gadelshina, S. V. (2025). Development of students' environmental thinking as a factor of economic growth, *Economics and Entrepreneurship*, (4), 170–174.

Mukhametkairov, A. E., Kotova, N. S., & Musatila, L. M. (2025). Development of school students' critical thinking in the process of project-based activity, *Pedagogical Bulletin of Kazakhstan, 3*(80), 72–87.

Smirnova, O. A. (2023). Features of organizing project-based activities in ecology in vocational education, *Trends in the Development of Science and Education*, (3), 50–54.

Titova, N. K. (2022). Project-based method as a psychological technology for developing university students' critical thinking, *Human Capital*, (4), 21–27.

Urunova, K., Akhmedova, N., & Esanbaeva, K. (2020). Pedagogical foundations of forming an ecological culture of technical university students. Tashkent.

Information about authors:

Mukhametzyanova Flera, Doctor of Pedagogical Sciences, Professor of the Department of Historical and Social Studies of the Institute of International Relations, History and Oriental Studies, Kazan (Volga Region) Federal University, ORCID: https://orcid.org/0000-0001-8865-3644, Email: florans955@mail.ru.

Dzhumagaziyeva Assel, Doctoral student (2rd year) of the Department of Pedagogy and Psychology, L.N. Gumilyov Eurasian National University, ORCID: https://orcid.org/0009-0008-4823-2499, E-mail: Dasel_84@mail.ru.

Iskakova Kuralay, PhD, Acting Associate Professor, Astana International University, ORCID: https://orcid.org/0000-0001-8362-6997, E-mail: kuralay2008@mail.ru

Dlimbetova Gaini, Doctor of Pedagogical Sciences, Professor, L.N. Gumilyov Eurasian National University, ORCID: https://orcid.org/0000-0003-3578-8996, E-mail: gaidk25@gmail.com.