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INTERDISCIPLINARY INTEGRATION AS A STRATEGY FOR DEVELOPING ENVIRONMENTAL COMPETENCIES IN PRE-SERVICE PRIMARY SCHOOL TEACHERS

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Abstract: The development of environmental competencies among future teachers is an important priority of modern pedagogical education, especially in the context of sustainable development and increasing ecological challenges. This article examines interdisciplinary integration as an effective strategy for developing environmental competencies in pre-service primary school teachers. The study is based on the idea that environmental education should not be limited to separate ecological disciplines, but should be integrated into the entire system of professional teacher training.

The purpose of the article is to substantiate the pedagogical potential of interdisciplinary integration in the development of environmental competencies among future primary school teachers. The research is grounded in competence-based, systemic, activity-based, and interdisciplinary approaches. The article analyzes the structure of environmental competence, identifies the main directions of ecological content integration into professional disciplines, and determines the pedagogical conditions necessary for its effective implementation.

The findings show that interdisciplinary integration contributes to the development of ecological knowledge, environmental values, practical pedagogical skills, and reflective readiness for environmental education. It enables future teachers to connect ecological issues with pedagogy, psychology, teaching methodology, language education, literary reading, and the subject "The Surrounding World". As a result, environmental competence becomes an integral component of professional teacher training.

The article concludes that interdisciplinary integration should be considered one of the key strategies for modernizing teacher education and preparing future primary school teachers for effective environmental education.

Keywords: environmental competence; interdisciplinary integration; pre-service teachers; primary education; teacher education; sustainable development; ecological culture.

Introduction

Environmental problems have become one of the most significant challenges of the twenty-first century. Climate change, depletion of natural resources, environmental pollution, land degradation, and loss of biodiversity require not only technological and economic solutions, but also fundamental changes in education. In this context, environmental education is increasingly regarded as an essential means of forming ecological culture, environmental responsibility, and sustainable behaviour among younger generations.

Teacher education occupies a central place in this process. The quality of environmental education in schools largely depends on the professional readiness of teachers to integrate ecological knowledge, environmental values, and practical activities into the educational process. This issue is especially important for primary education, because the foundations of children's worldview, moral values, emotional attitude toward nature, and behavioural habits are formed at the early stages of schooling.

The preparation of future primary school teachers should therefore include not only general pedagogical and methodological training, but also the systematic development of environmental competencies. These competencies enable teachers to explain ecological phenomena, organize

environmental activities, develop pupils' responsible attitudes toward nature, and integrate environmental content into different school subjects.

However, in many teacher education programmes environmental education remains fragmented. It is often limited to separate topics or individual ecological disciplines and is not sufficiently connected with professional pedagogical training. As a result, students may acquire certain ecological knowledge but experience difficulties in applying it in real teaching practice. This creates a need for interdisciplinary integration, which allows environmental content to be systematically included in various professional disciplines.

Interdisciplinary integration makes it possible to connect ecological content with pedagogy, psychology, methods of teaching the native language, literary reading, natural science education, and extracurricular activities. Such an approach helps future teachers understand environmental problems as complex phenomena connected with nature, society, culture, ethics, and education.

The relevance of this study is determined by the need to improve the ecological orientation of teacher education and to develop effective pedagogical strategies for forming environmental competencies among future primary school teachers. In the context of Uzbekistan, this problem is especially important due to regional environmental challenges, the need to improve ecological culture, and the implementation of sustainable development principles in the educational system.

The purpose of this article is to analyze interdisciplinary integration as a strategy for developing environmental competencies in pre-service primary school teachers and to identify the pedagogical conditions that ensure its effective implementation in higher pedagogical education.

2. Theoretical Background

The concept of environmental competence has gradually evolved from a narrow understanding of ecological literacy to a comprehensive professional characteristic that integrates knowledge, values, skills, attitudes, and behavioural readiness. Contemporary educational research considers environmental competence to be one of the key outcomes of teacher education because it enables future teachers to promote sustainable development through formal and non-formal education.

The competence-based approach serves as the theoretical foundation for developing environmental competencies in higher education. According to this approach, the educational process should focus not only on the acquisition of knowledge but also on the formation of practical abilities, professional values, independent thinking, and lifelong learning skills. Environmental competence therefore represents the ability of future teachers to apply ecological knowledge effectively in professional practice while demonstrating environmental responsibility and ethical decision-making.

Interdisciplinary integration is recognized as one of the most effective strategies for competency development because environmental problems cannot be adequately understood from the perspective of a single academic discipline. Environmental issues involve ecological, social, economic, psychological, cultural, and ethical dimensions, all of which should be reflected in teacher education programmes. Consequently, interdisciplinary learning enables students to develop systems thinking and to understand the complex interactions between humans and the environment.

Within primary teacher education, interdisciplinary integration creates opportunities to incorporate environmental content across professional disciplines. For example, pedagogy introduces theoretical principles of environmental education and sustainable development, while educational psychology explains the age-specific characteristics of children's environmental perception and behaviour. Courses in teaching methodology demonstrate effective instructional strategies for integrating ecological concepts into classroom practice.

Language and literary education also play an important role in environmental competence development. Literary texts describing nature, environmental protection, and human interaction with the natural world encourage emotional engagement and value formation. Through literary analysis,

discussion, and creative activities, future teachers learn to cultivate pupils' ecological awareness while simultaneously developing language competence.

Similarly, natural science education provides the scientific foundation for understanding ecosystems, biodiversity, climate change, environmental pollution, and sustainable resource management. Practical laboratory activities, field observations, and ecological investigations strengthen students' ability to organize inquiry-based learning for primary school pupils.

An important characteristic of interdisciplinary integration is the establishment of meaningful connections among academic disciplines rather than the simple inclusion of ecological topics within separate courses. This integration allows future teachers to perceive environmental education as a unified pedagogical process that combines scientific knowledge, educational methodology, ethical values, and practical teaching experience.

Based on the theoretical analysis, environmental competence in this study is considered an integrated professional characteristic comprising four interrelated components:

- **Value–motivational component** – environmental values, ecological responsibility, motivation for sustainable behaviour, and commitment to environmental education;
- **Cognitive component** – scientific environmental knowledge, understanding of ecological principles, sustainable development, and environmental legislation;
- **Activity–practical component** – the ability to organize environmental education, design interdisciplinary lessons, conduct environmental projects, and apply innovative teaching methods;
- **Reflective component** – self-evaluation, professional reflection, continuous improvement, and readiness for lifelong professional development.

The interaction of these components creates favourable conditions for preparing environmentally competent teachers capable of integrating sustainable development principles into primary education.

3. Materials and Methods

This study employed a qualitative research design supported by elements of pedagogical analysis. The research focused on identifying the pedagogical potential of interdisciplinary integration in developing environmental competencies among pre-service primary school teachers.

The study was conducted within the system of higher pedagogical education and was based on the analysis of professional training programmes for future primary school teachers.

To achieve the research objectives, several complementary methods were employed:

- analysis and synthesis of national and international scientific literature;
- comparative analysis of pedagogical approaches to environmental education;
- examination of teacher education curricula and professional training programmes;
- pedagogical observation of interdisciplinary instructional practices;
- analysis of educational documentation and methodological materials;
- generalization of pedagogical experience.

The theoretical framework of the research combines competence-based, systems, interdisciplinary, activity-based, and learner-centred approaches. Their integration made it possible to identify the pedagogical conditions necessary for effective environmental competence development.

The study focused on the integration of environmental content into the following professional disciplines:

- Pedagogy;
- Educational Psychology;
- Methodology of Teaching the Native Language;
- Literary Reading;
- Methodology of Teaching the Subject *The Surrounding World*;
- Educational Technologies;

- Teaching Practice.

The effectiveness of interdisciplinary integration was evaluated according to four criteria corresponding to the structural components of environmental competence:

1. Environmental awareness and ecological knowledge;
2. Environmental values and professional motivation;
3. Practical readiness for environmental education;
4. Reflective and self-development abilities.

The proposed interdisciplinary model emphasizes continuous interaction among academic disciplines, practical teaching experience, environmental projects, and reflective learning activities. Such integration creates favourable pedagogical conditions for developing future teachers capable of implementing environmental education effectively within primary schools.

4. Results and Discussion

The analysis of the research findings demonstrates that interdisciplinary integration significantly enhances the development of environmental competencies among pre-service primary school teachers. The incorporation of environmental content into professional disciplines created favourable pedagogical conditions for improving students' ecological knowledge, professional motivation, practical teaching skills, and reflective abilities.

Unlike traditional subject-centred instruction, the interdisciplinary approach enabled students to perceive environmental education as an integral component of their future professional activity rather than as an isolated academic discipline. Throughout the educational process, students gradually developed the ability to establish meaningful relationships between environmental issues, pedagogical theory, classroom methodology, and practical teaching activities.

A particularly important outcome of the study was the improvement of students' environmental awareness. Classroom discussions, interdisciplinary assignments, ecological projects, and analytical tasks encouraged students to understand environmental problems from scientific, educational, ethical, and social perspectives. This comprehensive understanding contributed to the formation of systems thinking, which is considered one of the essential competencies for sustainable development.

The research also revealed noticeable improvements in students' professional motivation. The interdisciplinary organization of learning activities increased their awareness of the teacher's responsibility in promoting environmental literacy among younger generations. Students increasingly recognized that environmental education should be integrated into everyday teaching practice rather than confined to science-related subjects.

Practical pedagogical competence also improved considerably during the implementation of the interdisciplinary model. Students successfully designed lesson plans incorporating environmental content into language education, literary reading, natural science, and extracurricular educational activities. They demonstrated the ability to organize classroom discussions, environmental observations, project-based learning, collaborative activities, and educational games that promoted ecological awareness among primary school pupils.

Reflective competence developed simultaneously with practical skills. Regular self-evaluation, peer discussion, and analysis of teaching practice encouraged students to assess their professional achievements critically and identify opportunities for further improvement. Reflection contributed to the development of professional responsibility and readiness for continuous self-development.

The overall results indicate that interdisciplinary integration influences all structural components of environmental competence simultaneously. Rather than improving isolated skills, the proposed model promotes comprehensive professional development.

Table 1. Expected Educational Outcomes of Interdisciplinary Integration

Environmental competence component	Educational outcomes
Value–motivational	Development of ecological values, environmental responsibility, and professional motivation
Cognitive	Improvement of environmental knowledge, systems thinking, and understanding of sustainable development
Activity–practical	Ability to integrate environmental content into primary education, organize projects, and conduct environmental activities
Reflective	Professional self-evaluation, critical reflection, lifelong learning, and continuous professional improvement

The findings of the present study correspond with contemporary international research emphasizing the importance of interdisciplinary learning in teacher education. Similar conclusions have been reported in studies devoted to sustainability competencies, which indicate that environmental competence cannot be developed effectively through isolated ecological disciplines alone. Instead, it requires continuous interaction among pedagogical, psychological, methodological, and environmental knowledge.

An important advantage of the proposed model is its flexibility. The interdisciplinary principles described in this study can be implemented in teacher education programmes regardless of national educational contexts. Universities may adapt the model by integrating environmental themes into existing curricula without introducing additional compulsory disciplines.

Another significant implication concerns curriculum development. Educational programmes preparing future primary school teachers should systematically incorporate environmental topics across professional disciplines rather than concentrating them within a single course. Such integration provides students with repeated opportunities to apply environmental knowledge in different educational contexts, thereby strengthening long-term competence development.

Overall, the findings confirm that interdisciplinary integration serves as an effective educational strategy for preparing environmentally competent primary school teachers capable of implementing sustainable development principles in school education.

5. Conclusion

The present study demonstrates that interdisciplinary integration represents an effective pedagogical strategy for developing environmental competencies among pre-service primary school teachers. The integration of environmental content into professional teacher education creates favourable conditions for the simultaneous development of ecological knowledge, environmental values, practical teaching skills, and reflective professional competence.

Unlike traditional approaches that consider environmental education as a separate academic subject, the interdisciplinary model proposed in this study emphasizes the systematic incorporation of environmental themes throughout the teacher education curriculum. Such an approach enables future teachers to establish meaningful connections between ecological concepts and various professional disciplines, thereby strengthening both theoretical understanding and practical readiness for environmental education.

The findings indicate that interdisciplinary integration contributes not only to improving students' environmental literacy but also to enhancing their professional competence, pedagogical creativity, systems thinking, and commitment to sustainable development. Future teachers become better

prepared to organize environmentally oriented learning activities, integrate ecological content into different subjects, and cultivate environmental responsibility among primary school pupils.

The practical significance of this research lies in the possibility of applying the proposed interdisciplinary model within teacher education institutions. Universities may incorporate environmental themes into existing pedagogical disciplines, develop interdisciplinary learning modules, expand project-based activities, and strengthen school practice related to environmental education.

Future research should focus on large-scale empirical investigations involving several universities, longitudinal evaluation of competence development, and comparative international studies aimed at identifying best practices in environmental teacher education. Such studies will further contribute to improving the quality of teacher preparation in accordance with the principles of sustainable development.

The interdisciplinary approach should therefore be regarded as one of the key directions for modernizing teacher education and preparing a new generation of environmentally competent teachers capable of responding effectively to contemporary environmental challenges.

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