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FORMATION OF SUSTAINABLE DEVELOPMENT COMPETENCIES IN FUTURE PRIMARY SCHOOL TEACHERS IN AN ACTIVITY-REFLECTIVE EDUCATIONAL ENVIRONMENT

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Abstract. The article substantiates the role of an activity-reflective educational environment in the formation of sustainable development competencies among future primary school teachers. The relevance of the study is determined by the growing need to prepare educators capable of implementing the principles of sustainable development in the context of contemporary socio-educational transformations and the integration of education into the global educational space.

The aim of the article is to provide a theoretical justification of the essence of an activity-reflective educational environment and to determine its potential in the formation of sustainable development competencies in future primary school teachers. The methodological framework of the study is based on systemic, competence-based, activity-based, and reflective approaches.

The essence of the activity-reflective educational environment as a holistic pedagogical system has been clarified. Its structural components have been identified, including content, activity, reflective, value-motivational, and socio-communicative components. The mechanisms of its influence on the formation of sustainable development competencies in future teachers have been substantiated. It has been demonstrated that the integration of active learning and reflection contributes to the internalization of sustainable development values and the formation of relevant knowledge, skills, and behavioral strategies.

The scientific novelty lies in defining the activity-reflective educational environment as a systemic pedagogical factor in the formation of sustainable development competencies in future primary school teachers.

The practical significance of the results lies in their potential application in designing educational environments in higher education institutions aimed at preparing teachers for the implementation of sustainable development principles.

Keywords: sustainable development competencies, future primary school teachers, activity-reflective educational environment, professional training, pedagogical conditions, education for sustainable development.

INTRODUCTION

Contemporary societal development is increasingly shaped by complex environmental, social, and economic challenges that require systemic and long-term responses across all domains of human activity. Climate change, depletion of natural resources, widening social inequalities, and global instability have intensified the demand for transformative educational strategies capable of fostering responsible, future-oriented thinking. Within this context, education for sustainable development (ESD) is widely recognized as a strategic framework for advancing sustainable societies and promoting responsible citizenship (Cebrián et al., 2020).

Within the ESD paradigm, education is no longer interpreted as a process of knowledge transmission but as a transformative practice aimed at developing learners' capacity for critical reflection, value-based judgment, and responsible action in complex and uncertain contexts. This reconceptualization positions education as a key driver of systemic societal change, where sustainability-oriented competencies become a central educational outcome (Alam, 2022).

Teachers occupy a pivotal role in this transformation, functioning as mediators of sustainability values and facilitators of pedagogical change. Research highlights that professional competence in ESD involves the integration of cognitive, ethical, and action-oriented dimensions, enabling educators to operate effectively in interdisciplinary and uncertain educational environments (Brandt et al., 2022). This issue is particularly significant in primary education, where foundational value systems, behavioral patterns, and environmental attitudes are formed.

Sustainable development competencies are currently conceptualized as multidimensional constructs that integrate knowledge, skills, values, and reflective capacities. This understanding has shifted pedagogical attention from knowledge reproduction toward activity-based and student-centered learning approaches that emphasize engagement with authentic sustainability challenges (Ruíz-Munzón & Buil-Fabregá, 2022; Luque-González, Fernández-Caminero & Álvarez-Castillo, 2025).

In this context, active learning methodologies, particularly project-based and problem-oriented approaches, are widely recognized as effective tools for fostering sustainability competencies in higher education. Empirical studies confirm their impact on strengthening students' awareness of sustainable development goals and enhancing professional growth through experiential engagement (Luque-González et al., 2025). Importantly, activity-based learning is increasingly interpreted not only as a pedagogical method but also as a structural condition for competency formation in teacher education (Kreminskyi et al., 2024).

Alongside activity-oriented approaches, reflective practice represents a fundamental dimension of teacher education. Reflection supports the development of professional self-awareness, critical thinking, and continuous pedagogical improvement (Frytsiuk, 2025). Reflexivity is further recognized as a personal resource that enables the integration of experience and the construction of a coherent professional identity (Zhaitapova et al., 2021). Contemporary research also highlights the multifunctional role of reflection in connecting experiential learning, critical thinking, and professional self-development (Chaikovska, 2025; Maxkambayeva, 2026).

Collaborative and cooperative learning approaches further emphasize the social dimension of competence development. Such approaches demonstrate that professional knowledge and sustainability competencies are constructed through interaction, dialogue, and shared meaning-making within educational communities (Marlina et al., 2025). This

perspective reinforces the understanding of competencies as socially mediated and context-dependent constructs.

Despite growing scholarly attention to ESD, teacher education, and competency development, existing research remains fragmented. Most studies examine isolated dimensions such as activity-based learning, reflection, or value formation, without sufficiently integrating these components into a unified theoretical framework. As a result, the interconnection between learning activity, reflective processes, and value internalization remains under-theorized (Chaikovska, 2022).

This fragmentation is also evident in the limited conceptualization of the educational environment as an integrated pedagogical system. Although recent studies increasingly acknowledge the importance of holistic learning environments, their structural and functional role in competency formation remains insufficiently elaborated (Chaikovska et al., 2024; Kreminskyi et al., 2024).

Therefore, there is a clear need to conceptualize the activity-reflective educational environment as a systemic framework that integrates cognitive, practical, reflective, and value-based dimensions of teacher education. Such an approach aligns with contemporary shifts in ESD toward transformative and competency-based paradigms that emphasize critical thinking, responsible decision-making, and sustainable professional behavior (Alam, 2022; Schönstein & Budke, 2024).

The aim of this article is to provide a theoretical justification of the essence of an activity-reflective educational environment and to determine its potential in the formation of sustainable development competencies in future primary school teachers. The scientific novelty lies in the conceptualization of this environment as a holistic pedagogical system integrating activity-based, reflective, value-motivational, and socio-communicative components into a unified model of competency formation in ESD.

LITERATURE REVIEW

Contemporary global challenges related to environmental degradation, social inequality, and economic instability have intensified scholarly attention to education for sustainable development (ESD) as a strategic direction for transforming educational systems worldwide. ESD is increasingly understood not merely as a curricular component but as a transformative educational paradigm aimed at fostering responsible citizenship and systemic thinking for sustainable futures (Alam, 2022; Cebrián et al., 2020).

A central assumption in contemporary research is that effective implementation of ESD requires a profound transformation of teacher education, as teachers serve as key agents of value transmission and pedagogical innovation. Their professional competence involves the integration of cognitive understanding, ethical positioning, and action-oriented pedagogical practice (Brandt et al., 2022). This is particularly critical in primary education, where foundational value orientations and behavioral frameworks are established.

Sustainability competencies are conceptualized as integrative constructs encompassing knowledge, skills, attitudes, and reflective capacities. This multidimensional interpretation has contributed to a shift from traditional transmissive models toward active, learner-centered approaches that emphasize engagement with real-world sustainability problems (Luque-González et al., 2025).

Within this paradigm, active learning methodologies, including project-based and experiential approaches, are widely recognized as effective mechanisms for competency development. Empirical evidence demonstrates that such approaches enhance students' understanding of sustainability goals while strengthening their capacity for professional

application of knowledge (Martínez Casanovas et al., 2022). In parallel, activity-based learning is increasingly interpreted as a structural condition of educational effectiveness rather than a purely methodological choice (Kreminskyi et al., 2024).

Reflective practice represents another essential dimension of teacher education. It is widely recognized as a mechanism for developing professional self-awareness, critical thinking, and continuous self-improvement (Ibragimova et al., 2025). Reflexivity further functions as a personal resource that enables future teachers to integrate experience and construct professional identity (Senchyna, 2023). Moreover, reflection is increasingly understood as a multifunctional construct linking experiential learning, critical reasoning, and professional development trajectories (Ovdiichuk, 2024; Maxkambayeva, 2026).

Collaborative learning approaches add an important social dimension to competency formation. They emphasize that knowledge construction occurs through interaction, dialogue, and shared problem-solving processes within learning communities (Zhou et al., 2025). This perspective aligns with contemporary understandings of sustainability competencies as socially constructed and context-dependent.

Despite substantial progress in ESD research, the literature remains fragmented in its theoretical integration of activity-based, reflective, and value-oriented dimensions of teacher education. Existing studies predominantly address these components separately, without establishing a coherent systemic framework that explains their interdependence (Chaikovska, 2022; Chaikovska et al., 2024; Chaikovska, 2025).

This fragmentation is further reinforced by the limited conceptualization of the educational environment as an integrated pedagogical system. Although the importance of holistic learning environments is increasingly acknowledged, their internal structure and mechanisms of influence on competency formation remain insufficiently theorized (Brandt et al., 2022; Maxkambayeva, 2026).

Accordingly, there is a strong need to conceptualize an activity-reflective educational environment as a systemic pedagogical construct that integrates cognitive, practical, reflective, and value-based dimensions of teacher education. Such a framework is consistent with contemporary ESD paradigms that prioritize transformative learning, critical thinking, and responsible professional action (Schönstein & Budke, 2024).

METHODOLOGY

Methodological framework.

The methodological framework of the study is grounded in systemic, competence-based, activity-based, and reflective approaches, the integration of which ensures a holistic understanding of the process of forming sustainable development competencies in future primary school teachers. The systemic approach made it possible to consider the activity-reflective educational environment as an integrated pedagogical system consisting of interrelated structural components. The competence-based approach guided the study toward defining educational outcomes through the formation of sustainable development competencies. The activity-based approach emphasized students' active participation in learning, practical, and research activities, while the reflective approach focused on processes of awareness, self-analysis, and rethinking of professional experience.

Research design and data sources.

The study is theoretical and conceptual in nature and does not involve the collection of empirical data. It is based on a systematic analysis of contemporary scholarly literature on education for sustainable development, teacher education, activity-based learning, and reflective practices. The research employed thematic analysis,

conceptual synthesis, comparative analysis of pedagogical approaches, and theoretical generalization of existing scientific findings.

Analytical procedures.

The method of conceptual modeling was used to develop a conceptual model for forming sustainable development competencies in future primary school teachers within an activity-reflective educational environment. This approach enabled the identification of interrelationships between the structural components of the model and the delineation of its systemic logic and functional interconnections.

RESULTS

Activity-Reflective Educational Environment as a System-Forming Pedagogical Construct

The results of the theoretical analysis position the activity-reflective educational environment as a system-forming pedagogical construct that determines the architecture of sustainable development competence formation in future primary school teachers.

In contrast to traditional interpretations, where the educational environment is reduced to organizational or didactic conditions, the proposed framework conceptualizes it as a dynamic system of interdependent interactions between activity, reflection, and value transformation. Within this system, the educational environment functions as a mediating structure that connects learning experience with the evolving professional identity of the teacher, enabling the gradual internalization of sustainability-oriented professional dispositions.

Structural Configuration of the Model: Invariant Components

The conceptual modeling enabled the identification of five invariant and functionally interrelated components that ensure the structural integrity of the system:

- content component (integration of sustainable development principles into curricular knowledge structures);
- activity component (implementation of practice-oriented and experiential learning);
- reflective component (systematic organization of self-analysis and professional reflection);
- value-motivational component (development of internalized professional and ethical orientations);
- socio-communicative component (construction of collective pedagogical meaning through interaction).

The interaction between these components is non-linear and network-based, corresponding to post-nonclassical understandings of educational systems as dynamic, open, and self-organizing structures. Their coherence ensures a transition from fragmented knowledge acquisition to an integrated competence configuration in the field of sustainable development.

Mechanisms of Competence Formation

The study demonstrates that competence formation is not a direct pedagogical transmission process but emerges through three interdependent mechanisms:

Mechanism of Activity Internalization

This mechanism is based on the involvement of future teachers in professionally oriented learning situations that simulate authentic pedagogical contexts. Through active engagement, theoretical knowledge is transformed into operational pedagogical actions.

Mechanism of Reflective Experience Reconstruction

This mechanism ensures the critical re-evaluation of learning experiences through structured reflection. It supports the development of professional self-awareness and enhances the capacity for self-regulated pedagogical decision-making.

Mechanism of Value Integration

This mechanism involves the transformation of cognitive and experiential outcomes into stable professional value systems that guide sustainability-oriented pedagogical behavior.

Together, these mechanisms form a cyclical developmental model in which each iteration of activity and reflection contributes to increasing levels of professional maturity.

Conceptual Model as an Integrative Theoretical System

The proposed model represents a non-linear integrative theoretical system in which competence formation unfolds through interconnected phases:

educational content → activity engagement → reflective processing → value internalization → professional competence

Importantly, this sequence should not be interpreted as linear causality but as a recursive system of feedback loops that ensures continuous deepening and restructuring of professional experience.

A visual representation of this process is presented in Figure 1.

Systemic Interpretation of Findings

The findings support three interrelated theoretical propositions:

First, the educational environment functions as an active system of professional transformation rather than a passive contextual background.

Second, competence formation follows a cyclical and process-oriented logic rather than a linear accumulation model.

Third, the integration of activity, reflection, and values generates a synergistic effect that accelerates professional identity formation in future teachers.

These propositions align with contemporary post-nonclassical pedagogy and transformative learning theory, both of which conceptualize education as a space of deep cognitive, value-based, and identity-related change.

DISCUSSION

The findings contribute to a reconceptualization of sustainable development competencies in teacher education by challenging the fragmented treatment of activity-based, reflective, and competence-oriented approaches. Instead of being treated as separate methodological domains, these dimensions are integrated within a unified activity-reflective educational environment that functions as a coherent systemic construct.

International ESD research increasingly emphasizes the integrative nature of sustainability competencies, which combine cognitive, value-based, and action-oriented dimensions (Cebrián et al., 2020; Brandt et al., 2022). However, most studies remain focused on defining competency outcomes, while the mechanisms of their formation remain under-theorized. The present model addresses this gap by explicating how the interaction of activity and reflection enables the progressive transformation of learning experience into stable professional structures.

Compared with dominant interpretations of active learning that emphasize instructional efficiency and knowledge acquisition (Martínez Casanovas et al., 2022), this study reframes activity as an ontological condition of professional identity formation rather than a didactic technique.

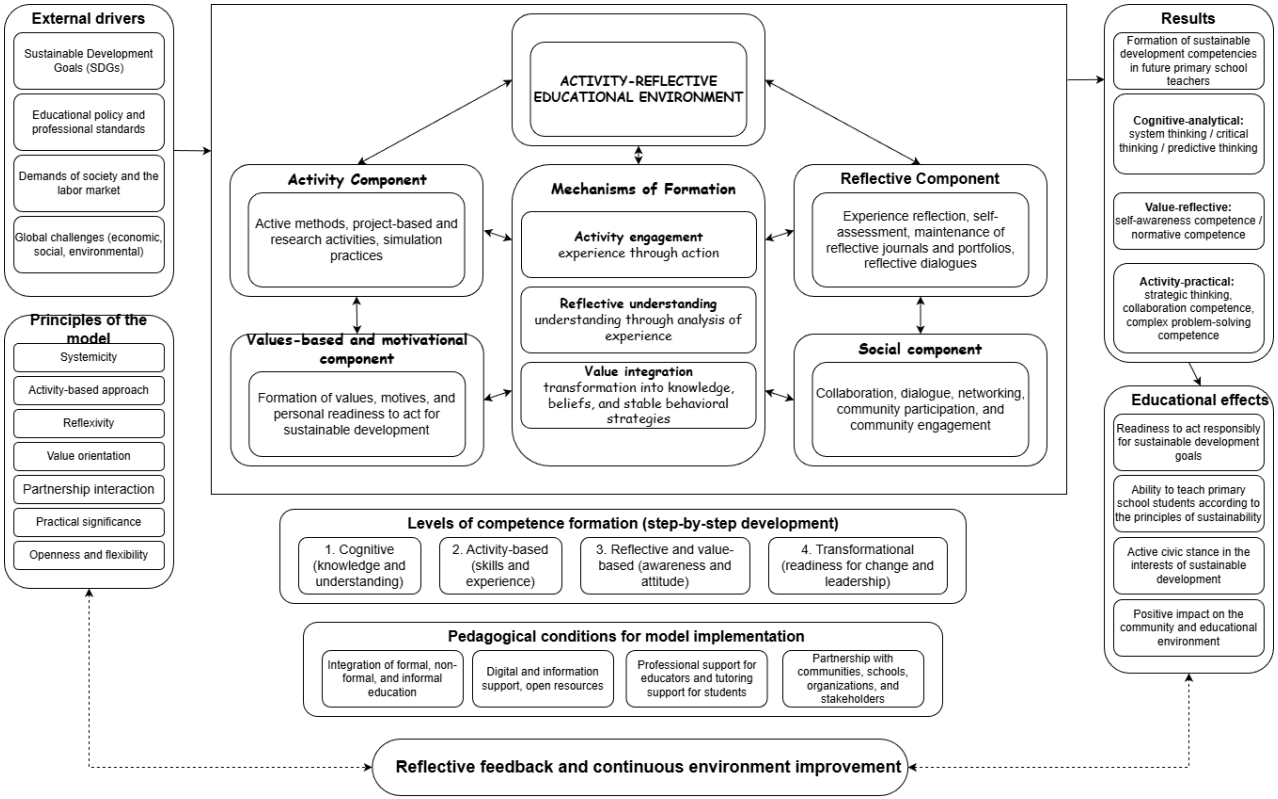


Figure 1. Conceptual model for the formation of sustainable development competencies of future primary school teachers in an activity-reflective educational environment

Similarly, reflection is reconceptualized not as a supplementary evaluative tool but as a structural principle that organizes the internal coherence of professional experience. This extends existing research on reflective practice in teacher education (Frytsiuk, 2025; Ibragimova et al., 2025) by embedding reflection into a systemic model of competence formation.

The study further confirms that sustainability competencies cannot be reduced to cognitive or methodological mastery. Their formation depends on the dynamic interplay of activity, reflection, and value construction, consistent with transformative learning theory.

Additionally, the socio-communicative dimension reinforces the collective nature of competence development. Collaborative interaction generates a synergistic effect in which professional meaning is co-constructed within learning communities (Zhou et al., 2025). Thus, sustainability competencies emerge as socially mediated and contextually embedded constructs rather than individual achievements.

The main scientific contribution lies in redefining the educational environment as a system-generating structure rather than a passive contextual background. This shift enables the integration of previously fragmented theoretical perspectives into a unified explanatory framework.

However, the conceptual nature of the study limits empirical validation, indicating the necessity of future operationalization and experimental verification.

CONCLUSIONS

The study provides a coherent theoretical reconstruction of sustainable development competence formation in future primary school teachers by positioning the activity-reflective educational environment as a system-forming pedagogical construct.

Competence development is reconceptualized as a non-linear, cyclical process driven by the interaction of learning activity, reflective practice, and value internalization. This dynamic structure ensures continuous transformation of professional experience and supports the emergence of sustainability-oriented pedagogical identity.

The educational environment is redefined as an active generative system that structures professional formation processes rather than serving as a contextual setting. This contributes to a more holistic understanding of teacher education within the paradigm of Education for Sustainable Development.

The proposed model integrates content, activity, reflection, value, and socio-communicative dimensions into a unified theoretical framework, offering a structured basis for redesigning teacher education programs in higher education institutions.

From a practical standpoint, the findings support the integration of experiential learning, structured reflection, and value-oriented pedagogical strategies into teacher training curricula.

The main limitation of the study lies in its theoretical nature. Future research should focus on empirical validation, operationalization of model components, and development of measurable indicators for assessing competence formation in real educational settings.

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ФОРМУВАННЯ КОМПЕТЕНТНОСТЕЙ СТАЛОГО РОЗВИТКУ У МАЙБУТНІХ УЧИТЕЛІВ ПОЧАТКОВОЇ ШКОЛИ В ДІЯЛЬНІСНО-РЕФЛЕКСИВНОМУ ОСВІТНЬОМУ СЕРЕДОВИЩІ

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Анотація. *У статті обґрунтовано роль діяльнісно-рефлексивного освітнього середовища у формуванні компетентностей сталого розвитку майбутніх учителів початкової школи. Актуальність дослідження зумовлена зростаючою потребою підготовки педагогів, здатних реалізовувати принципи сталого розвитку в умовах сучасних соціально-освітніх трансформацій та інтеграції освіти у глобальний освітній простір.*

Метою статті є теоретичне обґрунтування сутності діяльнісно-рефлексивного освітнього середовища та визначення його потенціалу у формуванні компетентностей сталого розвитку майбутніх учителів початкової школи. Методологічну основу дослідження становлять системний, компетентнісний, діяльнісний та рефлексивний підходи.

Уточнено сутність діяльнісно-рефлексивного освітнього середовища як цілісної педагогічної системи. Визначено його структурні компоненти: змістовий, діяльнісний, рефлексивний, ціннісно-мотиваційний та соціально-комунікативний. Обґрунтовано механізми його впливу на формування компетентностей сталого розвитку у майбутніх педагогів. Доведено, що інтеграція активної навчальної діяльності та рефлексії сприяє інтеріоризації цінностей сталого розвитку та формуванню відповідних знань, умінь і поведінкових стратегій.

Наукова новизна полягає у визначенні діяльнісно-рефлексивного освітнього середовища як системного педагогічного чинника формування компетентностей сталого розвитку майбутніх учителів початкової школи.

Практичне значення результатів полягає у можливості їх використання під час проєктування освітнього середовища закладів вищої освіти, орієнтованого на підготовку педагогів до реалізації ідей сталого розвитку.

Ключові слова*: компетенції сталого розвитку, майбутні вчителі початкової школи, діяльнісно-рефлексивне освітнє середовище, професійна підготовка, педагогічні умови, освіта для сталого розвитку.*

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