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PEDAGOGICAL CONDITIONS FOR THE DEVELOPMENT OF STUDENTS' ECOLOGICAL COMPETENCE IN THE MODERN EDUCATIONAL SPACE

Abstract: The aim of the study was to identify effective approaches to integrating environmental education into the learning process. The methodology included student surveys, interviews with teachers and parents, and an analysis of students' creative works. The level of environmental awareness among students and teachers was examined. Specifically, 58% of students regularly spend time in nature, but only 41% adhere to principles of environmentally responsible behaviour. Interactive methods are employed by 62% of teachers in delivering environmental education, and half of the students actively participate in creative projects focused on nature conservation. Survey results revealed that 81% of students understand waste segregation, yet only 39% practice it at home. During interviews, 67% of parents assessed their children's environmental awareness as high or sufficient, but 25% rarely discuss environmental issues at home. An analysis of students' creative works – including drawings, essays, and photo reports – showed that 78% of drawings depict the beauty of nature and the need for its preservation, while 64% of essays contain proposals for improving the environmental situation in their city. Furthermore, only 39% of families actively engage in waste segregation, indicating a need for improved environmental practices in the household. The results also demonstrated that 32% of students and 62% of teachers consider the integration of environmental topics across all disciplines important. The practical significance of the study lies in using these findings to develop recommendations for enhancing students' ecological competence through improved infrastructure, family involvement, and the implementation of interactive teaching methods.

Keywords: students, environmental awareness, conservation activities, innovative methods, civic responsibility

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Introduction

Climate change, which drives environmental pollution and the depletion of natural resources, has become increasingly urgent, making the development of ecological competence among learners particularly crucial. This competence entails not only acquiring knowledge about the environment but also fostering ecological awareness, a responsible attitude towards nature, and the ability to make decisions aimed at preserving and improving environmental conditions. As the primary institution of socialisation, the school plays a key role in nurturing a new generation of citizens capable of thinking ecologically and acting responsibly. Therefore, particular attention must be paid to examining the pedagogical conditions that facilitate the development of students' ecological competence: integrating an environmental component into the educational process, creating an appropriate developmental environment, implementing active and interactive teaching methods, and preparing teachers to deliver environmental education effectively. Research in this area not only identifies effective pathways for developing ecological competence but also contributes to the overall improvement of education quality, oriented towards achieving sustainable development and fostering responsible citizenship.

The issue of developing students' ecological competence has been widely explored in academic literature, with scholars analysing pedagogical conditions for fostering environmental awareness and sustainable learning approaches. For instance, Adieva et al. (2025) examined the integration of environmental education and economics in higher education institutions in Kyrgyzstan, emphasising the importance of interdisciplinary approaches in curricula. The researchers analysed key challenges in incorporating economics into education and highlighted that students' environmental awareness is more effectively developed through a combination of theoretical knowledge and practical initiatives. Canlas and Abdisalamovna (2024) investigated teachers' perspectives on implementing education for sustainable development in Kyrgyzstani schools, identifying the need for teacher support in this process. The authors stressed the importance of systematic professional development for educators to successfully implement environmental initiatives and noted that collaboration between schools, communities, and government bodies enhances the effective integration of sustainable development principles.

The study by Abakirov et al. (2025) examines the psychological and pedagogical factors influencing the effectiveness of environmental education in the context of globalization. The authors emphasize the need to cultivate holistic environmental consciousness that integrates cognitive, emotional-value, and behavioral components. Special attention is given to the role of the digital environment and global information flows in shaping young people's ecological perceptions. The study highlights the importance of adapting pedagogical strategies to contemporary sociocultural changes to strengthen students' environmental competence.

Kulueva et al. (2023) explored the digitalisation of education as a factor in regional sustainable development, particularly in the context of environmental education. The authors highlighted the importance of developing digital resources to facilitate effective learning about ecological issues. They also noted that digital tools can help promote sustainable practices among young people, especially in remote regions. The researchers underscored the necessity of interactive platforms to enhance ecology education and raise students' en-

vironmental awareness. Ergeshov et al. (2022) analysed the role of universities in establishing a competence-based approach, which includes an environmental component. The authors emphasised integrating ecological aspects into higher education curricula to cultivate students' environmental responsibility. They noted that universities have the potential to serve as models of sustainable development by offering environmentally oriented initiatives and projects at local and international levels. In her study, Kazakbaeva (2023) highlighted the importance of fundamental training for future teachers in fostering robust knowledge and ecological responsibility. The author stressed the need to integrate environmental topics into teacher education programmes and equip educators with tools for effective ecological literacy instruction. She argued that environmental education should be not only theoretical but also practical, providing students with actionable knowledge to address ecological challenges. Bordiug (2023) explored methodological foundations for developing ethnocultural competence in education, which can also be correlated with environmental education as part of the value-based component of learning. Sergey et al. (2024) conducted a comparative analysis of environmental education in higher education institutions in Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan, identifying common challenges and promising directions for development. Zulushova et al. (2021) investigated the development of students' independent thinking and ecological awareness through the analysis of water resources and bioecological features, highlighting the effectiveness of inquiry-based learning as a foundation for ecological competence.

Despite the aspects highlighted by the aforementioned authors, the gaps identified include insufficient integration of environmental education into the general learning process and limited attention to the development of environmental competence within teacher training programmes. Research does not always emphasise the necessity of actively engaging students in practical activities that foster the development of their ecological thinking and sense of responsibility.

The aim of the study was to identify key pedagogical conditions that facilitate the formation of students' environmental competence in modern educational settings. The research objectives included assessing the level of environmental awareness among students and educators in educational institutions, determining the effectiveness of methods and approaches used in implementing environmental education, and developing recommendations for enhancing students' environmental competence based on contemporary pedagogical practices.

Materials and methods

To examine the pedagogical conditions shaping students' environmental competence in the educational sphere, a comprehensive empirical methodology was implemented, combining quantitative and qualitative analysis with a focus on the southern region of Kyrgyzstan – the city of Osh. The primary research sites were Gymnasium No. 5 named after Zhoomart Bokonbaev and affiliated departments of Osh State University – Pedagogical Institute and Ecological-Biological College. The study was conducted from January 2022 to March 2024. The sample comprised 120 participants, including 80 gymnasium students (grades 5-9) and 40 first- and second-year students from Osh State University. The respondents' average age ranged from 10 to 19 years, with a nearly equal gender distribution (61 female, 59 male). The study was conducted in Kyrgyz and Russian. Inclusion criteria consisted of enrolment in the specified educational institutions, participation in environmental initiatives

within the past year, and voluntary consent (parental consent for minors). Participants not enrolled in the selected institutions or lacking interest in environmental topics were excluded. Data collection was carried out through two primary methods: surveys and structured interviews. The survey was administered via Google Forms and consisted of 15 closed-ended questions (Table 1).

Table 1. Student questionnaire

Question	Possible answers
1. How often do you spend time in nature?	Daily/1-2 times a week/Rarely
2. What do you do with waste after outdoor activities?	Dispose in a bin/Take home/Leave it
3. Are you aware of waste segregation?	Yes/No
4. What sources do you use for environmental information?	YouTube/Instagram/School lessons/Other
5. Have you attended any environmental courses?	Yes/No
6. How do you feel when witnessing environmental pollution?	Sadness/Anger/Shame/Indifference
7. Do you turn off lights when leaving a room?	Always/Sometimes/Never
8. Do you use reusable bottles or bags?	Always/Sometimes/Never
9. Which environmental issue in your city concerns you most?	Landfills/Air pollution/Deforestation/Other
10. What changes would you implement in your school/college to improve sustainability?	More bins/Green spaces/Eco-lessons/Other
11. What is your attitude towards school/park clean-ups?	Positive/Neutral/Negative
12. Does your family practise waste sorting?	Yes/No
13. Does your school/college have a nature corner or eco-lab?	Yes/No
14. What environmental action are you proud of?	Planted a tree/Cleaned an area/None
15. What could improve Osh's environmental situation?	Education/Government policies/Community initiatives/Other

Source: Created by the authors

Structured interviews were conducted with 8 teachers (Table 2) and 12 parents (Table 3), either via Zoom or phone calls, using closed-ended questions.

Table 2. Teacher interview questions

Question	Possible answers
1. How is environmental education integrated into your curriculum?	Embedded in courses/Extracurricular activities
2. Do you organise practical environmental activities?	Yes / No
3. Which methods are most effective in fostering environmental awareness?	Interactive lessons/Project-based learning/Group work/Excursions
4. What challenges arise in implementing environmental education?	Lack of funding/Scarcity of teaching materials/Student passivity
5. What role do digital platforms play in this process?	Supplementary/Key
6. Does the school/university administration support eco-initiatives?	Actively/Partially/Formally
7. What outcomes of environmental education do you value most?	Behavioural change/Critical thinking/Civic engagement

Source: Created by the authors

Table 3. Parent interview questions

Question	Possible answers
1. How would you rate your child's environmental awareness?	High/Adequate/Moderate/Needs improvement
2. Do you discuss nature and conservation at home?	Regularly/Occasionally/Rarely or never
3. Do you involve your child in household eco-practices?	Yes/Partially/Rarely
4. How do you respond to school eco-initiatives?	Positively, with support/Neutrally
5. What could improve environmental education in schools?	More hands-on activities/Parental involvement/Digital tools/Modern pedagogy

Source: Created by the authors

In addition, an analysis of students' creative works (drawings, essays, photo reports) submitted via Telegram groups as part of environmental challenges was conducted. All stages of the research were carried out in compliance with ethical principles, namely informed consent, voluntary participation, anonymity, confidentiality, and adaptation to age-specific characteristics. The study adhered to the provisions of the Code of Ethics of the American Sociological Association (2018).

To analyze the data collected through surveys and interviews, a mixed-methods approach was applied. For the quantitative data obtained from the surveys, descriptive statistics were used to calculate frequencies and percentages for each response, allowing for an overview of students', teachers', and parents' environmental awareness and practices. For the qualitative data from the structured interviews, thematic analysis was conducted. Responses were categorized based on recurring themes related to environmental education, such as the integration of eco-initiatives in curricula, teaching methods, and challenges faced. This combination of quantitative and qualitative methods enabled a comprehensive understanding of the current state of environmental education and its effectiveness. The data processing was done using SPSS software for the statistical analysis and NVivo for coding and analyzing interview responses.

Using a strengths, weaknesses, opportunities, and threats (SWOT) analysis, key aspects of existing pedagogical practices were identified, as well as factors influencing the development of environmental education in the region. Based on the collected data, recommendations for educators were developed.

Results

Assessment of the level of environmental awareness among students and educators in educational institutions

Environmental education must extend beyond school walls, fostering students' awareness of their role in addressing global ecological challenges. This entails cultivating critical thinking, systemic analysis, decision-making, and ethical reasoning. Such education will shape a new generation of citizens capable of living in harmony with nature and promoting sustainable development in their regions, countries, and the planet as a whole (Kariippanon et al., 2020; Shynkaruk, 2025). Thus, environmental education emerges as a key investment in the future. It is not merely knowledge but also a mindset, a cultural norm, and a lifestyle. The goal is to cultivate individuals who not only recognise the importance of ecological issues but are also prepared to act responsibly at all levels – from personal habits to civic engagement. Schools, as social institutions, have a unique opportunity to lay these

foundations early, nurturing conscious, empathetic, and environmentally responsible citizens. To assess the level of environmental beliefs, behavioural strategies, and responsible attitudes towards nature among students, a survey was conducted, the results of which are presented in Table 4.

Table 4. Survey results

Question	Responses (%)
1. How often do you spend time in nature?	Daily – 12% 1-2 times a week – 58% Rarely – 30%
2. What do you do with waste after outdoor activities?	Dispose of it in a bin – 41% Take it home – 30% Leave it behind – 29%
3. Are you aware of waste segregation?	Yes – 81% No – 19%
4. What sources do you use for environmental information?	YouTube – 32% Instagram – 21% School lessons – 12% Other – 35%
5. Have you attended any environmental courses?	Yes – 32% No – 68%
6. How do you feel when witnessing environmental pollution?	Sadness – 34% Anger – 27% Shame – 15% Indifference – 24%
7. Do you turn off lights when leaving a room?	Always – 62% Sometimes – 29% Never – 9%
8. Do you use reusable bottles or bags?	Always – 19% Sometimes – 57% Never – 24%
9. Which environmental issue in your city concerns you most?	Landfills – 38% Air pollution – 28% Deforestation – 14% Other – 20%
10. What changes would you implement in your school/college to improve sustainability?	More trash bins – 31% Green areas – 27% Eco-lessons – 15% Other – 27%
11. What is your attitude towards school/park clean-ups?	Positive – 84% Indifferent – 10% Negative – 6%
12. Does your family practise waste sorting?	Yes – 39% No – 61%
13. Does your school/college have a nature corner or eco-lab?	Yes – 45% No – 55%
14. What environmental action are you proud of?	Planting a tree – 26% Cleaning an area – 22% None – 52%
15. What could improve Osh's environmental situation?	Education – 33% Government regulation – 19% Community initiatives – 17% Other – 31%

Source: Created by the authors

The survey data indicate a general level of environmental awareness among the youth of Osh, albeit with certain discrepancies between knowledge and actual practices. Specifically, 81% of respondents are aware of waste sorting, yet only 39% reported that their families actually practice it. This suggests a certain level of environmental consciousness among students but also reveals several problematic aspects. The results show that digital platforms serve as the primary source of environmental information for most respondents: 32% obtain information via YouTube, 21% via Instagram, while only 12% cited school lessons as a knowledge source. This situation may diminish the quality of environmental knowledge

acquisition and limit the depth of problem comprehension. The insufficient participation of students in specialised ecology courses (only 32% had such experience, compared to 68% who did not) further reinforces this conclusion.

At the same time, a high level of emotional engagement with environmental issues is evident in the responses: 34% of respondents feel sadness, 27% anger, and 15% shame when witnessing environmental pollution. This creates a favourable foundation for fostering environmental activism, provided that students are offered appropriate opportunities for practical involvement. A significant proportion of respondents (84%) expressed a positive attitude towards participating in clean-up activities, yet more than half (52%) could not provide a personal example of an environmental action, indicating a gap between motivation and practical implementation. The results also demonstrate that, in addressing environmental issues in their city, students primarily rely on education (33%), while 19% consider state regulation crucial, and 17% emphasise community initiatives. This underscores the importance of strengthening the environmental component in curricula and promoting eco-initiatives among youth.

To examine parents' and educators' attitudes towards environmental education and assess its effectiveness in the modern educational landscape, interviews were conducted, with the results presented in Tables 5 and 6.

Table 5. Teachers' interview responses

Question	Responses (%)
1. How is environmental education integrated into your curriculum?	Integrated courses – 62% Extracurricular activities – 38%
2. Do you organise practical environmental activities?	Yes – 100% No – 0%
3. Which methods are most effective in fostering environmental awareness?	Interactive lessons – 50% Project-based learning – 25% Group work field trips – 25%
4. What challenges arise in implementing environmental education?	Insufficient funding – 50% Lack of methodological resources – 25% Student passivity – 25%
5. What role do digital platforms play in this process?	Supplementary – 75% Key – 25%
6. Does the school/university administration support eco-initiatives?	Yes actively – 62% Partially/formally – 38%
7. What outcomes of environmental education do you value most?	Behavioural change in students – 50% Critical thinking civic engagement – 50%

Source: Created by the authors

An analysis of the teachers' responses reveals that environmental topics are primarily integrated into general education courses, as reported by 62% of educators, while 38% incorporate them through extracurricular activities. All respondents (100%) indicated that they conduct practical environmental lessons or campaigns, demonstrating a strong readiness among teachers to engage students in hands-on environmental education. According to the teachers, the most effective methods for fostering environmental awareness include interactive lessons (50%), project-based learning (25%), and group work or field trips (25%). The main challenges in implementing environmental education, as identified by the teachers, are insufficient funding (50%), a lack of methodological resources (25%), and student passivity (25%). These challenges highlight the need for better resource support and motivational programs to engage students more effectively. Regarding the role of digital platforms, 75% of teachers view them as supplementary tools, while 25% assign them a

more central, key role in the learning process. In terms of institutional support, 62% of teachers reported active backing from the school or university administration, while 38% indicated only partial or formal involvement. The outcomes of environmental education that teachers value most are behavioral changes in students and the development of critical thinking and civic engagement, each cited by 50% of respondents. This reflects the broader goals of environmental education, which not only aim to increase knowledge but also to foster an active, responsible life stance in students.

Table 6. Parents' interview responses

Question	Responses (%)
1. How would you rate your child's environmental awareness?	High/sufficient – 67% Moderate/needs improvement – 33%
2. Do you discuss nature and conservation at home?	Yes, regularly – 25% Yes, occasionally – 50% Rarely or never – 25%
3. Do you involve your child in household eco-practices?	Yes – 83% Partially/rarely – 17%
4. How do you respond to school eco-initiatives?	Positively supportive – 75% Neutrally – 25%
5. What could improve environmental education in schools?	More hands-on activities, parental involvement – 58% Digital tools, modern teaching methods – 42%

Source: Created by the authors

The parental interview results show that 67% assess their children's level of environmental awareness as high or sufficient, while 33% consider it average and in need of improvement, suggesting overall positive trends in environmental responsibility formation but also pointing to further work required. Nature and environmental conservation topics are regularly discussed in 25% of households, occasionally in 50%, and rarely or never in 25%, reflecting uneven environmental upbringing within families. Meanwhile, 83% of parents involve their children in household eco-practices, an important factor in cultivating environmental culture at a practical level, though 17% do so only partially or infrequently. Support for school eco-initiatives was expressed by 75% of parents, while 25% remain neutral, indicating a generally favourable family attitude towards school-led environmental activities. Parents believe that enhancing the effectiveness of environmental education requires more practical activities and family involvement (58%), as well as greater use of digital tools and modern teaching methods (42%), underscoring a demand for updated approaches in environmental education.

Analysis of the effectiveness of applied methods and approaches in environmental education

An examination of students' creative works (drawings, essays, photo reports) submitted as part of Telegram challenges demonstrated a high level of emotional engagement with environmental conservation themes. In 78% of drawings, the dominant themes were the beauty of nature and its protection (depictions of trees, animals, clean rivers, the Earth held in children's hands). 64% of essays contained personal narratives about environmental care, examples from family or school life, while 58% included specific proposals for improving Osh's ecological situation (e.g., waste sorting, eco-lessons, creating green spaces). In 71% of photo reports, children documented their participation in clean-ups, tree planting, or posting informational leaflets on eco-habits. Overall, the creative outputs revealed that

most participants not only possess basic environmental knowledge but are also capable of emotionally processing ecological issues, demonstrating initiative, and seeking localised solutions. This indicates the development of a value-based attitude towards nature, empathy, responsibility, and active citizenship – key components of environmental competence.

A SWOT analysis was conducted to evaluate pedagogical practices in developing students' ecological competence. This analysis identified the strengths and weaknesses of existing approaches, as well as opportunities and threats related to the implementation of environmental education. The results are presented in Table 7, enabling a deeper assessment of the efficacy and future prospects of environmental education in schools and colleges.

Table 7. SWOT analysis of pedagogical practices in developing students' environmental competence

Strengths	**Weaknesses**
Active student participation in conservation activities (clean-ups, tree planting)	Insufficient material and technical resources for environmental education
Support from teachers and parents	Lack of systematic integration of environmental topics across all subjects
Presence of eco-challenges and creative tasks	Limited teacher knowledge of innovative eco-practices
Use of digital platforms (Canva, Telegram, Google Forms)	Low preparedness of some students for independent ecological reasoning
Opportunities	**Threats**
Expanding collaboration with non-governmental organisations and environmental initiatives	Lack of stable funding for environmental projects
Implementation of Science, Technology, Engineering, Arts and Mathematics (STEAM) approaches in environmental education	Influence of urbanisation and consumerist values on youth awareness
Engaging local media and social networks to promote ecological awareness	Insufficient monitoring of local environmental policy implementation
Organising inter-school eco-festivals, online competitions	Passivity among some parents

Source: Created by the authors

The SWOT analysis reveals that the key strengths of pedagogical practices in environmental education include students' active participation in conservation activities, support from teachers and parents, and the presence of eco-challenges and creative tasks. However, there are also notable weaknesses, such as limited material and technical resources for environmental lessons, the lack of systematic integration of ecology across all subjects, and insufficient training for some educators in contemporary eco-practices. Among the opportunities are expanded collaboration with civil society organisations and the implementation of STEAM approaches in education, which could significantly enhance the quality of environmental education (Abdrakhmanov et al., 2024; Ramey et al., 2024). At the same time, threats include the absence of stable funding and the influence of urbanisation and consumerist values on young people's attitudes towards nature (Bazaluk, 2018; Zhao et al., 2025). These factors underscore the necessity of a comprehensive approach to developing ecological competence, considering both existing advantages and significant challenges.

The research findings indicate the need for a holistic model of environmental education that accounts for local cultural, social, and economic specificities. The effectiveness of educational initiatives increases significantly when traditional pedagogical methods are combined with digital tools and active interaction among participants in the educational

process. Particular attention should be given to strengthening cross-sectoral collaboration between educational institutions, local authorities, community initiatives, and families. Furthermore, emphasis should be placed on enhancing participants' motivation not only through awareness-raising but also through personally meaningful experiences, engagement in real-world ecological projects, and recognition of each pupil's contribution. In the long term, this will help create an educational environment where ecological consciousness becomes an integral part of a child's worldview rather than merely a requirement of the school curriculum.

Discussion

Pedagogical approaches and digital integration in developing environmental competence

Environmental protection and education are increasingly crucial in the context of global climate change, pollution, and resource depletion. These issues have evolved from scientific or activist concerns to integral components of sustainable development strategies, with education playing a central role. Education shapes new values, behavioral attitudes, and responsible environmental approaches, particularly among younger generations. The term "ecology," originally referring to the study of organism-environment interactions, has expanded to encompass planetary conservation, nature protection, responsible resource management, eco-ethics, and environmental consciousness (Luft et al., 2022; Klikh et al., 2025; Tkach et al., 2020).

Environmental education aims to foster knowledge, skills, and competencies for harmonious human-nature relationships. It is an interdisciplinary field integrating natural, social, and humanities knowledge, grounded in ecocentrism, shared responsibility, global thinking, and local action. A central goal is cultivating environmental consciousness - the ability to recognize environmental issues and connect them to personal behavior, driving nature conservation decisions (Kazakbaeva, 2023; Zatserkovnyi, 2025). This consciousness must be systematically cultivated through education, personal example, social interaction, and cultural narratives.

Various pedagogical approaches inform environmental education. The traditional approach focuses on transmitting theoretical knowledge, while the constructivist approach emphasizes active student participation through problem-solving and project-based activities (Datskovsky et al., 2018; Luzan et al., 2021). The eco-humanistic approach fosters an emotional connection with nature and the ethical dimensions of environmental interaction (Hussain et al., 2022). Increasingly, an integrated model combining cognitive, emotional, and activity-based components is being applied. Digital technologies further enhance environmental education by enabling virtual field trips, online challenges, and personalized learning, broadening student outreach and developing ecological competence (Hamilton et al., 2021; Varenyk and Piskova, 2025).

Despite these advancements, environmental education faces challenges such as fragmented curricula, insufficient teacher training, limited resources, and low administrative and community support. Environmental initiatives are often implemented superficially, which reduces their effectiveness and impact (Niyazova et al., 2013; Salykova et al., 2022). Effective educational approaches engage students emotionally, offer opportunities for action, and allow them to witness the outcomes of their efforts. Practical activities, creative projects,

collaborative work, and reflective practices are particularly effective in fostering responsible environmental attitudes. It is also crucial to tailor education to students' age, interests, and cultural contexts (Krutsevich et al., 2019; Titova and Sosnytska, 2020). Teachers play a pivotal role as facilitators of sustainable development values. Their motivation, stance, and pedagogical expertise are key to making environmental education a meaningful part of the educational environment (Lukyanenko et al., 2025; Yeraliyeva et al., 2016).

The study's findings underscore the importance of establishing effective pedagogical conditions for developing students' environmental competence within the educational space. Successful integration of an environmental component into the curriculum was found to correlate closely with factors such as digitalisation in education, updated pedagogical approaches, innovative learning environments, and the cultivation of critical thinking among learners (Chung, 2025; Lungu and Silistraru, 2021). The results affirm the need to transform pedagogical conditions towards more ecologically oriented and technologically supported teaching. These conclusions align with the work of Aliman and Mutia (2021), who emphasised the efficacy of digital environmental solutions in enhancing pedagogical competence and students' ecological awareness through innovative educational materials. The study demonstrated that digital textbooks improved knowledge retention, cognitive development, and ecological perspectives. Significant attention was also given to teachers' technological proficiency, consistent with the findings of Asad et al. (2021). This study highlighted that educators' techno-pedagogical competencies were decisive in shaping students' environmental consciousness in digital environments, enabling more effective use of interactive, ecology-focused resources. The research also identified challenges related to insufficient digital literacy among teachers, corroborating the conclusions of Araujo-Vizuete et al. (2022). While digital technologies hold considerable potential for modernising environmental education, their effective application remains limited by inadequate teacher training. Another key aspect was the organisation of innovative learning environments, examined through the lens of new pedagogical approaches. This resonates with the work of Charteris et al. (2020), who analysed innovative learning environments from a "new materiality" perspective, emphasising the role of space, infrastructure, and environment in facilitating ecological learning. Closs et al. (2022) highlighted the direct influence of learning environments on student engagement. Their study in an Australian business and economics faculty demonstrated that spatial organisation significantly affected motivation, participation, and cognitive activity – indirectly fostering ecological awareness by creating a conducive learning context.

Digital pedagogy and learner autonomy also played a key role in the study. The findings were consistent with the research by Díaz-Noguera et al. (2022), who examined online learning during the COVID-19 pandemic. They demonstrated that students' environmental responsibility increased under conditions of motivation, digital literacy, and pedagogical support, which fully aligned with the results of the current study. The study by De Vera et al. (2021) focused on educators' competencies in educational technology, which directly influenced the quality of teaching methodologies in new educational contexts. It was established that environmental education was more effective when digital techniques were applied. Research by Georgievna (2020) concluded that updating the content of educational literature, particularly in higher education, contributed to more effective development of environmental competence. It was found that learning materials, particularly the integration of ecological themes into curricula, ensured content relevance and fostered ecological thinking. The study by Gulnoz and Nazira (2020) highlighted the effectiveness of information

and communication technologies in foreign language learning; however, the proposed methods were universal and successfully adapted to environmental education. The results demonstrated that interactive platform-based and digital tool-driven methods increased learners' engagement with ecological topics. In their work, Hadjichambis and Paraskeva-Hadjichambi (2020) proposed the concept of education for environmental citizenship. They established that developing environmental competence required not only knowledge but also active student involvement in environmentally significant activities, which aligned with conclusions on the necessity of practical orientation in environmental learning.

The effectiveness of critically oriented pedagogy, based on engaging students in studying local environmental issues through project-based activities, was demonstrated by Häggström and Schmidt (2020). This approach contributed to the development of both ecological and general literacy among students. The study's results were consistent with these findings, as learner participation in active, locally oriented activities proved to be a crucial factor in forming a conscious environmental stance. Kariippanon et al. (2020) emphasised the importance of flexible learning spaces as adaptive systems capable of responding to changing student needs. Adapting the educational environment to learners' requirements facilitated more effective implementation of ecologically oriented pedagogical strategies. The use of innovative educational technologies also significantly influenced the development of environmental competence. Hamilton et al. (2021) substantiated the effectiveness of virtual reality immersion for achieving deeper cognitive outcomes in learning. The study confirmed that interactive platforms, particularly ecological simulations, enhanced student motivation, deepened their understanding of ecological interconnections, and raised awareness of the consequences of human activity. Ikramovna (2023) conceptualised environmental competence as an integrated outcome of the educational process, shaped by learning content, pedagogical interaction, and the external educational environment. It was found that environmental competence was not limited to knowledge alone but encompassed attitudes, values, and readiness for active environmental behaviour. Further supporting the significance of a holistic approach, the work of Monte and Reis (2021) developed a pedagogical model of environmental citizenship in primary education. The authors stressed the importance of interdisciplinary learning and emotional engagement with environmental issues. These findings also aligned with the perspectives of Sebastián-López and de Miguel González (2020), who highlighted the role of mobile learning in preparing teachers to deliver sustainability education. It was established that using mobile applications for eco-monitoring, environmental studies, and observing natural processes fostered practical skills and heightened ecological sensitivity among students.

Crucial insights were provided by Mamurov et al. (2020), who demonstrated the effectiveness of an acmeological approach to fostering healthy lifestyles among students. Applying a similar approach to environmental competence development allowed the educational process to be reoriented towards personal growth and cultivating students' internal responsibility for the state of the environment. Mettis and Väljataga (2021) analysed the potential of hybrid outdoor learning. Such an educational framework diversified learning practices and stimulated cognitive engagement, positively influencing students' ecological awareness. The work of Sasson et al. (2022), Onipko (2025) confirmed the importance of designing new educational environments incorporating innovative pedagogical practices. The study found that effective environmental competence formation occurred when traditional learning spaces were transformed into settings promoting open dialogue, co-creation, and

practice-oriented learning. Wang et al. (2022) examined sustainability as an integral component of higher education curricula. The research proved that environmental education should be cross-cutting and aimed at developing competencies essential for a sustainable future. The authors emphasised the necessity of an interdisciplinary approach, integrating ecological knowledge with social and economic dimensions of sustainable development. They also underscored the importance of engaging students in real-world projects and research activities to cultivate responsible environmental attitudes.

Recommendations for enhancing students' environmental competence through modern pedagogical practices

Based on the findings of a comprehensive empirical study conducted in the Osh region of Kyrgyzstan, targeted recommendations were formulated for educators seeking to foster effective development of students' environmental competence within the educational environment. Data collected from questionnaires, interviews, and creative assignments revealed both the strengths of existing pedagogical practices and gaps requiring methodological refinement and strategic reconsideration. First and foremost, attention should be given to the need for active implementation of cross-curricular environmental integration. As evidenced by teacher interviews, environmental topics are in most cases confined to individual lessons within the natural sciences or extracurricular activities. However, approaches to environmental education demand its integration across all academic disciplines: humanities, mathematics, and the arts. For instance, literature classes could discuss nature-themed works, mathematics lessons could analyse environmental statistics, and art classes could create visual materials on ecological themes. This approach enables students to perceive environmental issues as multidimensional and relevant across various life contexts. The study demonstrated that most students actively engage with platforms such as Telegram and Google Classroom and show interest in visual content and dynamic forms of interaction. This presents significant opportunities for implementing environmental web quests, online challenges, interactive presentations, and video analyses of ecological situations. Furthermore, digital tools facilitate continuous information exchange among educational stakeholders, rapid dissemination of environmental initiatives, and documentation of positive outcomes.

Parent interviews revealed that while a significant proportion of families are interested in their children's environmental education, many lack adequate knowledge or resources. In this context, it is advisable to develop joint school-family educational initiatives, organise family eco-actions, conduct awareness campaigns, and share examples of sustainable household practices. This fosters a cohesive educational ecosystem where children receive consistent value-based guidance both at school and at home. Another critical recommendation involves the establishment of school eco-laboratories. Analysis of student responses confirmed that access to a physical space for observing nature, conducting experiments, or working on eco-projects significantly enhances motivation for environmental learning. While conditions in some Osh schools do not yet fully meet these requirements, the engagement of educational stakeholders suggests that creating such laboratories is both a realistic and necessary prospect. Eco-laboratories could be equipped with mini-greenhouses, indoor plant displays, microscopes, waste-sorting kits, and informational boards. They could also serve as hubs for project-based learning, integrating scientific inquiry with hands-on student work.

Special attention must be paid to fostering environmental empathy and ecological thinking. Additionally, analysis of creative assignments (essays, drawings, photo reports) highlighted the importance of nurturing students' individual "environmental voice". Children willingly share personal reflections, thoughts, and observations related to nature. Such work can form the basis for thematic exhibitions, school eco-magazines, or video blogs. Recommendations for educators in this regard include creating a safe space for self-expression, encouraging reflection, and emphasising each participant's individual contribution. An ethical approach to environmental education implementation is equally crucial. All stages of the study adhered to principles of voluntary participation, informed consent, anonymity, confidentiality, and age-appropriate considerations. This ethical framework is recommended for school-based environmental programmes, as it not only safeguards children's rights but also builds trust in the educational process, promoting openness, collaboration, and personal engagement. Finally, it should be noted that these recommendations are not universal templates but must be adapted to specific institutional conditions, student age groups, available resources, and regional characteristics. Nevertheless, the strategic direction of change lies in creating a holistic pedagogical environment where students' environmental competence develops not sporadically but systematically – through daily educational experiences, collaborative activities, and personal growth. Only under such conditions can lasting impact be achieved, ensuring that children not only know they must protect nature but genuinely desire to do so and are prepared to act responsibly.

Conclusions

The study's results confirmed the significance of establishing effective pedagogical conditions for fostering students' environmental competence. Successful integration of ecological components into education was closely linked to digital learning, innovative teaching methods, supportive educational environments, and the development of critical thinking. The conclusions aligned with numerous contemporary studies, which highlighted the necessity of techno-pedagogical teacher training, curriculum renewal, and active learner engagement in practice-oriented activities focused on sustainable development.

The study identified a range of factors that determine the pedagogical conditions for the development of students' environmental competence in the modern educational space. Based on the results of surveys conducted among students, teachers, and parents, several key conclusions can be drawn. Although most students visit natural settings regularly, a significant portion does not engage in responsible waste disposal, indicating a gap in environmental responsibility. This highlights the need for stronger environmental education practices to address the issue of littering in natural areas. While most students are familiar with waste sorting, fewer families actively practice it, suggesting a lack of environmental awareness in household settings. According to teacher interviews, environmental topics are primarily integrated into core curricula, with a smaller proportion incorporated through extracurricular activities. All teachers conduct practical environmental lessons or initiatives, with interactive lessons being the most favored method, followed by project-based learning and group work or field trips. However, many educators identified insufficient funding as a major challenge, limiting the implementation of new teaching methodologies and tools.

Families also actively support environmental initiatives but do not always involve children in daily eco-friendly practices. For instance, 83% of parents reported engaging

their children in household environmental practices, yet 25% admitted that they do not regularly discuss nature conservation at home. Regarding students' creative works, 78% of drawings reflected themes of environmental protection – depicting trees, animals, clean rivers, and the Earth – demonstrating a high level of emotional engagement with environmental issues. Additionally, 64% of students' essays contained personal narratives, confirming their foundational knowledge of nature and willingness to care for the environment. Moreover, 58% of students proposed specific suggestions for improving the ecological situation in Osh, including waste sorting, eco-lessons, and the creation of green spaces. Thus, the study demonstrated that students' environmental competence is shaped not only through formal instruction but also through practical activities involving both teachers and parents. The findings underscore the importance of a comprehensive approach to environmental education, encompassing not only theoretical knowledge but also active practical measures such as environmental campaigns, projects, and interactive lessons.

Several recommendations were formulated to enhance environmental education in schools. It is necessary to expand the material and technical resources for environmental lessons and provide students and teachers with appropriate methodological materials. Families should be more actively involved in environmental initiatives and practices, as 61% of households do not sort waste at home. Additionally, the integration of environmental topics across all academic disciplines should be broadened to ensure students' comprehensive understanding of ecological issues.

One of the main limitations of the study is the restricted sample size, which includes only students and teachers from a single city. Further improvements in environmental education may involve the development of new methodological resources for teachers, the establishment of online platforms for experience-sharing, and the use of digital tools for student learning, all of which would contribute to raising environmental awareness among youth.

Conflicts of Interest: The authors declare no conflict of interest.

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