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Ecological Culture and Critical Thinking: Building of a Sustainable Future

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Abstract: The pursuit of a sustainable future necessitates the integration of critical thinking into environmental education, as it plays a crucial role in equipping individuals with the necessary skills and knowledge to address complex environmental challenges. This article aims to examine the significance of critical thinking in the educational framework for cultivating ecological culture. By exploring the relationship between critical thinking skills and sustainable practices, the study analyzes how critical thinking abilities can contribute to creating a solid foundation for a sustainable future. This article presents the findings of a sociological survey conducted between March and June 2023, focusing on assessing the development of environmental culture competencies among residents of Yekaterinburg City (N = 250). The survey utilized a Google Form as the data collection tool. Statistical analysis was performed using the Vortex program version 10.0. The study findings indicate a significant level of ownership and shared responsibility among residents, suggesting their active engagement as catalysts for positive change in fostering a sustainable and equitable society. The findings of the study revealed that the city's ecological situation is considered one of the most urgent issues by the citizens of Yekaterinburg. The article proposes a model of ecological culture in academic disciplines and presents a structured approach to raising environmental awareness in conjunction with the integration of critical thinking into academic disciplines.

Keywords: critical thinking; education; ecological culture; sustainability; environmental awareness

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1. Introduction

In the aspiration of a sustainable future, the concept of sustainable development has emerged as a guiding principle for societies worldwide. Sustainable development seeks to address the interrelated challenges of environmental degradation, social inequality, and economic instability, while ensuring the well-being and prosperity of present and future generations [1–3].

The Sustainable Development Goals encompass 17 interconnected objectives, ranging from eliminating poverty and hunger to promoting gender equality, sustainable cities, and climate action [4]. These goals recognize the complex and interdependent nature of global challenges, emphasizing the need for integrated solutions that transcend traditional disciplinary boundaries. Achieving the Sustainable Development Goals requires a paradigm shift in our approach to economic, social, and environmental systems. It demands the adoption of sustainable practices across various sectors, including energy, agriculture, transportation, and manufacturing. Moreover, it necessitates the active involvement of governments, businesses, civil society organizations, and individuals in pursuing transformative actions.

Key principles underpinning the Sustainable Development Goals include the conservation and sustainable use of natural resources, the promotion of social equity and inclusivity, and the integration of environmental considerations into decision-making processes at all levels. These principles are anchored in the belief that economic development and environmental protection are not mutually exclusive, but rather, mutually reinforcing [5].

Central to the concept of sustainable development is the recognition of planetary boundaries, which define the ecological limits beyond which human activities risk jeopardizing the stability and functioning of the Earth system [6,7]. These boundaries encompass various critical factors, such as climate change, biodiversity loss, deforestation, freshwater availability, and chemical pollution. Adhering to these boundaries is essential for preserving Earth's life-supporting systems and ensuring a sustainable future.

Building a sustainable future necessitates a shift in mindset from short-term gains to long-term benefits, from exploitative practices to regenerative ones, and from individualism to collective action. It requires the adoption of innovative technologies, the promotion of sustainable consumption and production patterns, and the empowerment of marginalized communities [8–10]. Furthermore, it demands the integration of sustainability principles into education, research, policymaking, and governance processes of education, enabling holistic and inclusive approaches to sustainable development [11–14].

Media has emerged as a powerful medium influencing public opinion, shaping social norms, and disseminating information [15,16]. The media plays a significant role in shaping public opinion and disseminating information. It can provide valuable insights into important environmental issues, raise awareness, and promote sustainable practices. However, the media can also be a source of fake news or misinformation, which can distort the understanding of environmental problems and hinder informed decision making [17–19].

The *Cambridge Dictionary* defines "Fake News" as false stories that resemble news and are propagated on the internet or through other media platforms. These stories are usually created to influence political views or as a joke [20]. However, the concept of Fake News has been around for hundreds, if not thousands, of years, and includes various practices and strategies for the spread of illegitimate information. These practices include political propaganda, disinformation, rumors, parody, and satire.

The modern era has been dubbed "post-truth". According to the *Oxford Dictionary*, the term was first used in 2016 and refers to circumstances where objective facts have less impact on public opinion than emotional appeal and personal belief [21]. P. Mikhailidis and S. Viotti have proposed the term "Post-Fact" society to describe this trend [22]. They argue that the digital environment, combined with the information search habits of internet users, makes it easier for technological manipulations to influence users. As a result, it becomes challenging for users to access dependable, factual, and up-to-date information.

Critical thinking refers to the ability to analyze and evaluate information objectively, questioning its credibility, biases, and motives. It helps individuals distinguish between accurate information and fake news, enabling them to make informed judgments about environmental issues. Critical thinking helps individuals separate reliable environmental information from fake news perpetuated by the media [23–25]. Environmental thinking encourages individuals to consider the environmental implications of their actions and make informed decisions. Environmental thinking refers to the awareness and consideration of environmental factors in decision-making processes. It involves recognizing the interconnectedness of human activities and the environment and striving to minimize negative impacts while promoting sustainability and conservation [26,27].

Thus, media education and critical thinking serve as vital tools for promoting sustainable consumption and production patterns and empowering marginalized communities [28–30]. By integrating necessary resources and media literacy, a comprehensive approach can be adopted to support sustainable development goals. Media literacy refers to the ability to critically analyze and evaluate media messages. By promoting media literacy, individuals can develop the skills to navigate through the vast amount of information available and differentiate between credible sources and fake news. This empowers people to make informed decisions, including those related to sustainable development. Media literacy education can be integrated into school curricula or conducted through public awareness campaigns to promote critical thinking and responsible media consumption.

In the face of global environmental challenges, building a sustainable future has become a pressing concern for societies worldwide. Achieving sustainability requires indi-

viduals to develop a deep understanding of ecological concepts, adopt pro-environmental attitudes and behaviors, and engage in critical thinking to address complex environmental issues. Environmental education plays a crucial role in cultivating these skills and empowering individuals to be active participants in shaping a sustainable future [31–35].

The initial discussion on sustainability revolved around the utilization of critical thinking, with a focal point on maintaining a dynamic balance among the social, economic, and environmental dimensions to construct a more promising future [36–39].

Nevertheless, recent years have witnessed a growing recognition by several scholars regarding the necessity of incorporating non-conventional elements of sustainable development within the discourse. For instance, Ramos et al. [40] underscore the significance of defining the boundaries of sustainable development to assimilate novel predicaments and paradigms alongside traditional ones. The authors place specific emphasis on integrating aspects such as ethics, aesthetics, and culture, along with intangible values such as cooperation, solidarity, and empathy, which represent emerging concerns previously disregarded in earlier approaches.

Several models are available that offer distinct perspectives and strategies for attaining a sustainable future. These models furnish valuable insights into different facets of sustainability and offer guidance for action across multiple scales, ranging from individual actions to global initiatives. Let us take a closer look at some of these models. Kate Raworth introduced the Doughnut Economics model, which offers a conceptual framework for establishing the boundaries of human well-being within the constraints of planetary limitations [41].

The model strives to guarantee universal access to essential resources necessary for a prosperous life, while also operating within the ecological limits of the planet. Paul Hawken, Amory Lovins, and L. Hunter Lovins proposed a model that focuses on creating economic value while preserving and restoring natural resources [42]. The model emphasizes resource efficiency, biomimicry, and renewable energy, among other strategies, to achieve sustainability. The Ecological Civilization model advocates for a societal transition that prioritizes ecological well-being, resource sustainability, social justice, and participatory democracy [43]. William McDonough and Michael Braungart promote the design of products and systems that eliminate the concept of waste. It emphasizes using materials that can be continually recycled or composted and designing products with the intention of being "upcycled" or remanufactured [44].

There are several educational models aimed at sustainability, and many scientists have made significant contributions to this field. For example, David Orr explores the importance of integrating sustainability and environmental awareness into education at all levels [45]; Fritjof Capra delves into the interconnectedness of ecological, social, and economic systems [46]; Paulo Freire emphasizes the importance of critical thinking, dialogue, and participatory approaches in education [47]; John Dewey provides a foundation for hands-on, inquiry-based learning in sustainability education [48]; Arjen Wals has written on sustainability education, transformative learning, and the importance of integrating personal and emotional dimensions into sustainability education [49–51].

The cultivation of critical thinking skills in students is widely recognized as a crucial objective of higher education. Scholarly inquiry in this area reveals a multitude of definitions for critical thinking, as noted by S. Hale [52] (p. 45). However, J. Dewey's framework of reflective thinking serves as a cornerstone for subsequent discussions on this subject. Although J. Dewey does not explicitly employ the term "critical thinking", contemporary researchers associate his concept of reflective thinking with its essence [53]. J. Dewey characterizes reflective thinking as an active, persistent, and attentive examination of opinions or knowledge in relation to their underlying foundations, as well as an analysis of the subsequent conclusions they engender [54].

Contemporary research in the field of critical thinking concentrates on the advancement of skills and abilities associated with critical thinking. This area of study was first systematized in 1941 by E. Glazer when developing the "Watson Glaser Critical Thinking

Appraisal", a test specifically designed to assess critical thinking proficiency [55]. Using the 2002 edition of this test as an illustrative example, it becomes evident that it aims to evaluate the following skills:

1. Inference construction: individuals are expected to provide justifications for inferences drawn from various factual statements while assessing their soundness;
2. Assumption identification: within a series of statements, individuals must detect implicit assumptions or premises that underlie the given information;
3. Argument evaluation: individuals are tasked with determining whether conclusions logically follow from the information presented in the given statements or premises, or if they merely possess an associative relationship;
4. Deductive reasoning: individuals are required to infer generalizations or conclusions from the provided data;
5. Logical interpretation: individuals must evaluate the arguments presented in terms of their coherence, simplicity, and compatibility with broader systems of knowledge.

The significance of E. Glazer's concept lies in recognizing that individuals possess an inherent disposition and preparedness for engaging in critical thinking. The skills assessed by the test, in a broader context, serve as indicators of a person's inclination to deliberately contemplate problems and phenomena. A. Fisher highlights a crucial aspect of E. Glazer's theory, emphasizing that merely possessing these skills is insufficient; one must also be capable of employing them when necessary. Developing the habit of utilizing these skills and being prepared to apply them is of utmost importance [56] (p. 12). Consequently, researchers extensively examined and discussed the aspects of critical thinking as a means of enhancing human capability and constructing a quantifiable framework [57,58].

Critical thinking is the ability to analyze and evaluate information objectively and independently [59–61]. Thus, critical thinking is a fundamental skill for navigating the complexities of environmental challenges. It involves questioning assumptions, examining evidence, considering multiple perspectives, and applying logical reasoning to make informed decisions. In the context of environmental education, critical thinking facilitates the development of ecological literacy, enabling individuals to understand the interconnections between humans and the environment, and critically evaluate environmental issues.

The values held by higher educational institution teachers have an impact on the content, learning outcomes, and pedagogical methods used in teaching. The role of values in an academic's response to sustainable development in education and their influence on discipline development has been highlighted by Thomas [62]. Burford et al. [63] identified three new dimensions of sustainability (cultural-aesthetic, political-institutional, and religious-spiritual), which complement the traditional pillars. The need for a new generation of professionals who can approach education from this perspective calls for the modernization of higher education structures to foster sustainable development [64,65].

The growing societal awareness of sustainable development issues and the urgency to address them contrasts with the slow progress in integrating sustainable development into university curricula. Despite the efforts made by universities, the changes have been deemed inadequate and insufficiently rapid [40,66]. This context prompts a questioning of traditional approaches to sustainable development and teaching methods. Moreover, the importance of capacity building and empowerment is emphasized, supporting participatory approaches to transformation [67–69].

Environmental education aims to promote environmental awareness, knowledge, skills, and values in individuals to foster a sense of responsibility and action toward sustainability. However, the mere acquisition of knowledge alone is insufficient to tackle the multifaceted environmental problems we face. It is essential that individuals develop the ability to critically analyze and interpret the information they encounter, ensuring that their decisions and actions are based on accurate and reliable data.

Furthermore, critical thinking skills enable individuals to challenge prevailing norms and assumptions, encouraging innovative approaches to environmental problem-solving. By evaluating different solutions, considering potential consequences, and generating

creative alternatives, individuals can contribute to the development of sustainable strategies that address environmental challenges holistically.

In recent years, there has been increasing recognition of the importance of critical thinking in environmental education [70]. Educators have sought to incorporate critical thinking into curricula and teaching practices, recognizing that it is essential for developing environmentally responsible citizens who can actively contribute to sustainable development. By fostering critical thinking skills, environmental education equips individuals with the tools to navigate and negotiate the complex web of environmental information, enabling them to make informed decisions and take effective action toward a sustainable future.

This paper explores the role of critical thinking in environmental education and its contribution to building a sustainable future. It examines the theoretical foundations of critical thinking, explores its implications for environmental education, and highlights effective strategies for integrating critical thinking into educational programs. By investigating the interplay between critical thinking skills and sustainable practices, this study intends to unravel how the development of critical thinking capabilities can contribute to the establishment of a solid foundation for sustainability.

The development of critical thinking skills is essential in promoting an environmentally conscious society. Individuals who possess these skills are capable of evaluating information from various angles, enabling them to comprehend the multifaceted causes and effects of environmental issues and connections between ecological systems. Moreover, critical thinking empowers individuals to differentiate between reliable sources and misinformation, a vital skill in today's digital age where biased narratives and false information abound. Through this approach, people can make informed decisions and avoid perpetuating false narratives that hinder environmental progress. Additionally, critical thinking fosters reflective behavior, enabling individuals to assess their actions and environmental impact and make responsible decisions that minimize their ecological footprint. By continuously seeking knowledge and staying informed about global environmental challenges, critical thinkers become active participants in addressing environmental problems.

To cultivate a culture of critical thinking that leads to sustainable practices, responsible decision-making, and heightened awareness of collective responsibility toward environmental protection and preservation, society can adopt the Ecological Culture Model in Educational Disciplines. This approach involves integrating critical thinking skills into educational curricula and fostering a mindset that values objective analysis, information evaluation, reflective behaviors, and self-directed learning. By doing so, individuals will be empowered to address environmental challenges effectively. Considering the global drive for sustainable development and environmental preservation, the need for critical thinking capabilities within society is more pressing than ever. Therefore, adopting the Ecological Culture Model in Educational Disciplines provides a structured approach to integrating critical thinking into educational disciplines, promoting a heightened awareness of collective responsibility toward environmental stewardship.

2. Materials and Methods

This study aims to investigate the impact of critical thinking on the development of environmental culture. Critical thinking skills are vital in fostering an understanding of complex environmental issues and promoting sustainable behaviors.

In the first stage, an extensive review of relevant literature was conducted. The focus was on identifying and analyzing existing studies that have explored the relationship between critical thinking and environmental culture. This stage provided a theoretical foundation for the subsequent stages of the study.

Building on the insights gained from the literature review, the second stage involved designing the research framework. This included defining the research objectives, formulating research questions or hypotheses, and identifying the appropriate research methodology. At this stage, questions for sociological research were formulated. The sociological

research design aimed to capture the multidimensional aspects of critical thinking and environmental culture.

The third stage entailed data collection from a diverse sample of participants. The data collection tool employed in this study was a Google Form survey, while the statistical analysis was conducted using Version 10.0 of the Vortex program. The choice of the Vortex program for statistical analysis in the study "Ecological Culture and Critical Thinking" can be attributed to its suitability for analyzing complex ecological data and its alignment with the study's objectives and research questions. The choice of the Vortex program for statistical analysis in this paper is consistent with the study's objectives and research questions. The Vortex program is often employed in ecological research to assess the risk factors, probabilities, and potential impacts on populations of different species. The Vortex program offers a range of statistical tools to analyze such data accurately.

The study included 250 respondents living in the city of Yekaterinburg (Russia), among which the following age groups were distinguished: 18–30 years old (Group 1), 31–45 years old (Group 2), and 46–54 years old (Group 3). Group 1 was 80 people, Group 2 was 93 people, and Group 3 was 77 people. When entering the survey, respondents had to consent to the survey and answer the question of how old they were. Citizens under the age of 18 were not taken into account in this study, as they constitute a category of minors whose consent to the survey must be given by their parents or guardians.

The invitation for participation in the study was extended to residents of Yekaterinburg, regardless of their social status. The primary requirement for participation was a willingness to take part and demonstrate concern for existing issues. The study was not restricted to students, enabling a comprehensive analysis of multiple age groups. It is worth noting that only citizens with an interest in environmental issues participated in the survey, while those indifferent to the problem did not take part. The use of Google Forms instead of a printed version allowed for the inclusion of opinions from citizens who were not indifferent to the problem. Online forms eliminated the need for culling procedures.

A study was carried out in Yekaterinburg, the administrative center of the Sverdlovsk region in Russia. This region is the largest in the Urals and has a high concentration of production, which affects its socio-economic situation. The public organization determines the environmental rating of the constituent entities of the Russian Federation [71]. In recent years, the Sverdlovsk Region has shown some improvement, ranking 83rd in the summer of 2021, up from 85th in the spring of 2019. In 2022, the Sverdlovsk Region ranking was 84. However, other regions have demonstrated more stable dynamics, indicating a better environmental situation. For instance, the Nizhny Novgorod region ranked 58th in 2020 and 51st in 2021, while Moscow ranked 6th in 2021 and 5th in 2020. In 2022, the top five regions included the Tambov Region, Belgorod Region, Altai Republic, Kursk Region, and Moscow.

Environmental protection is a priority for the authorities in the Sverdlovsk region [72,73], as outlined in the Action Plan for the implementation of the Fundamentals of State Policy in the field of environmental development of the Russian Federation [74] and the National project "Ecology" [75]. To effectively address environmental problems, a constructive dialogue with the public is necessary, and this is a priority for all stakeholders, including those in the online space.

The administration of Yekaterinburg is taking measures to improve the environmental conditions in the region, such as supporting the Ural Environmental Initiative since 2016 [76]. The initiative aims to create a sustainable ecosystem for the Ural region, based on principles of sustainable development and partnerships with the scientific and expert community, and the youth movement. However, the environmental rating indicates that more needs to be done to address the environmental challenges in the Sverdlovsk region, given the high concentration of production that causes technogenic load. Environmental safety remains a critical issue for sustainable development in the region.

The study of the influence of critical thinking on the development of ecological culture was carried out based on establishing the correspondence of competencies at 5 levels:

Level 1: The Basic Understanding and Opinion Seeking section of the questionnaire aimed to assess the participant's foundational knowledge and attitudes towards environmental issues. It revealed their awareness of key concepts and their belief in the role of individual actions in addressing environmental problems.

Level 2: The Application and Analysis section of the questionnaire assessed the participant's ability to apply their knowledge of environmental issues and analyze their behavior and its impact on the environment. It focused on their understanding of specific topics related to consumer choices, research, and analysis, consideration of long-term consequences, and biodiversity.

Level 3: The Reflection and Evaluation section of the questionnaire explored the participant's ability to reflect on their behaviors and evaluate information related to environmental issues. It assessed their critical thinking skills, willingness to change, curiosity about global environmental challenges, and understanding of the underlying causes of environmental problems.

Level 4: The Integration and Synthesis section of the questionnaire delved into the participant's ability to integrate and synthesize knowledge and experiences related to environmental issues. It assessed their understanding of climate change and its impacts, involvement in environmental advocacy or activism, communication skills regarding environmental issues, and application of sustainable design or planning principles.

Level 5: The Advanced Analysis and Application section of the questionnaire aimed to assess the respondents' competence in integrating critical thinking skills into their decision-making processes, and their understanding of the role critical thinking plays in addressing complex environmental challenges.

Evaluating responses in Level 5 enables the identification of individuals who possess advanced analytical skills and can effectively apply critical thinking to address complex environmental challenges. These individuals show extensive integration of environmental considerations into decision-making processes, a strong belief in the importance of critical thinking, a comprehensive understanding of critical thinking principles, recognition of critical thinking's role in promoting environmental awareness and education, the ability to provide diverse examples of critical thinking in action, and an understanding of how critical thinking can enhance students' understanding of environmental concepts.

The choice of this multi-level methodology for studying the influence of critical thinking on the development of ecological culture is justified for several reasons.

Firstly, the multi-level methodology allows for a comprehensive assessment of the participants' competencies at different stages of their development. By dividing the assessment into five distinct levels, the study can capture the progression of critical thinking abilities from basic understanding to advanced analysis and application. This ensures that the full spectrum of the participants' competencies is considered, providing a more nuanced and in-depth understanding of their critical thinking skills.

Secondly, the multi-level approach provides a clear framework for assessing critical thinking concerning ecological culture. Each level of the methodology corresponds to specific aspects of critical thinking skills and their application to environmental issues. This structured approach ensures that the assessment is focused and targeted, allowing for a more precise examination of the participants' competencies concerning ecological culture.

Additionally, the multi-level methodology allows for the identification of gaps and areas of improvement in the participants' critical thinking skills. By assessing competencies at different levels, the study can pinpoint specific areas where the participants may need further development or support. This information can then be used to design targeted interventions or educational programs to enhance critical thinking abilities in the context of ecological culture.

Moreover, the multi-level approach acknowledges the complexity of critical thinking and its role in addressing complex environmental problems. By including a level specifically dedicated to advanced analysis and application, the methodology recognizes that critical thinking is not a static skill but rather a dynamic process that evolves with increasing

knowledge and experience. This level also emphasizes the importance of integrating critical thinking skills into decision-making processes, highlighting the practical relevance of critical thinking in solving real-world environmental challenges.

Thus, the choice of a multi-level methodology for studying the influence of critical thinking on the development of ecological culture is justified as it allows for a comprehensive assessment of competencies, provides a clear framework for assessment, identifies areas of improvement, and recognizes the dynamic nature and practical relevance of critical thinking skills. This methodology, when applied rigorously, can contribute to a deeper understanding of the relationship between critical thinking and ecological culture, and inform the design of effective educational interventions to foster critical thinking in the context of environmental issues.

Assigning numerical parameters to the answers can help measure the level of understanding and opinion-seeking. Respondents could choose only one answer to the question. By assigning numerical values to the responses, we calculated a cumulative score for everyone (Appendix A). The higher the score, the higher the level of understanding and opinion-seeking. For example, a total score of more than 10 points might indicate a high level of maturity of competence. If an individual has a cumulative score of 9–6 points, it indicates an average level of maturity of competence. If an individual has a cumulative score of 5–4 points, it indicates a low level of maturity of competence.

The analysis of the data will offer insights into the influence of critical thinking on the development of environmental culture. The implications for educational interventions, policymaking, and practice will be discussed, highlighting potential avenues for promoting critical thinking skills in the context of environmental education.

3. Results

Critical thinking, defined as the ability to objectively analyze and evaluate information, plays a crucial role in fostering an environmentally conscious mindset and behavior. The impact of critical thinking on the development of environmental culture lies in its ability to empower individuals to think critically, question assumptions, evaluate information, reflect on their behaviors, and pursue knowledge. Figure 1 shows the results of a sociological study on the impact of critical thinking on the development of the environmental culture of the citizens of Yekaterinburg.

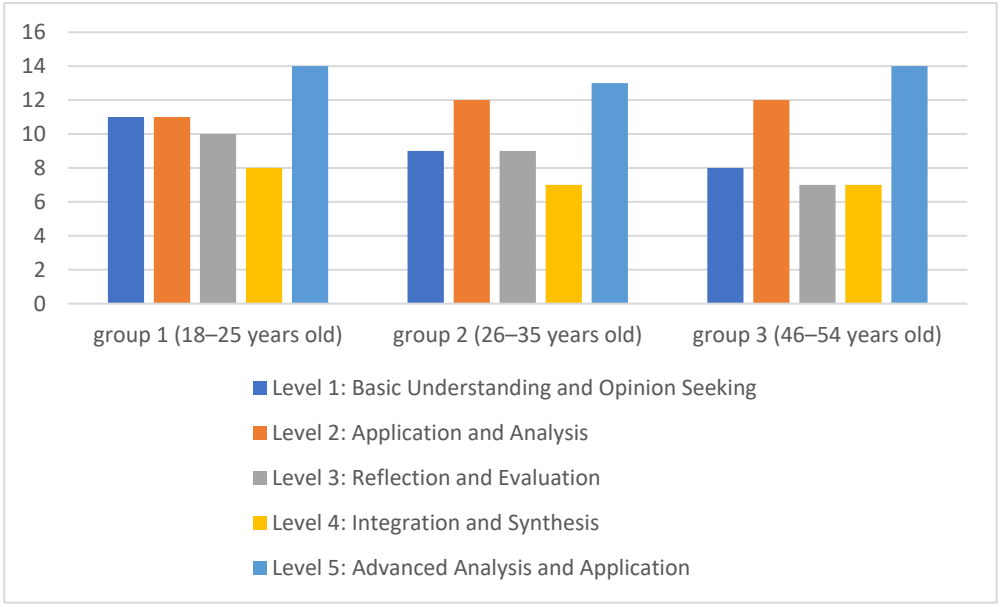

Figure 1. Impact of critical thinking on the development of environmental culture.

Figure 1 shows how critical thinking competencies are formed, which have an impact on the development of an ecological culture based on establishing the correspondence of competencies at 5 levels.

Level 1: Basic Understanding and Opinion Seeking.

The indicators shown by the respondents when answering the Level 1 questions are a high (Group 1) and an average level (Group 2, Group 3) of maturity of competence, which indicates a high level of competence formation in all groups:

Group 1 (18–30 years old): 11.

Group 2 (31–45 years old): 9.

Group 3 (46–54 years old): 8.

The indicators of competence formation at Level 1 include:

Familiarity with basic environmental concepts: Individuals at Level 1 demonstrate a basic understanding of fundamental environmental concepts such as pollution, conservation, natural resources, or climate change. They are aware that these issues exist but may have limited knowledge of the specific details or complexities involved;

Awareness of environmental challenges: Level 1 individuals show an awareness of some environmental challenges and problems that need to be addressed. They may have a general understanding of some of the major environmental issues, such as air or water pollution, deforestation, or waste management, but may not yet have a comprehensive understanding of the underlying causes or potential solutions;

Seeking information and opinions: Individuals at Level 1 actively seek information and opinions about environmental issues. They may engage in discussions, read articles or blogs, or watch documentaries to learn more about various environmental topics. Level 1 individuals are curious and open to exploring different perspectives and viewpoints related to the environment;

Basic understanding of the role of individual actions: Level 1 individuals have a basic understanding that individual actions can contribute to addressing environmental problems. They might believe that small changes in personal behavior, such as recycling or using energy-efficient appliances, can make a difference. However, their understanding of the broader systemic and collective actions necessary for substantial environmental change may be limited at this stage;

Formation of initial environmental attitudes: Individuals at Level 1 begin to form their attitudes towards environmental issues. They may exhibit concern for the environment or express a desire for a healthier planet. However, their attitudes may still be influenced by personal experiences, societal values, or limited exposure to environmental knowledge.

These indicators collectively demonstrate in respondents the formation of foundational knowledge and attitudes at Level 1. Individuals at this level possess some understanding of basic environmental concepts and challenges, actively seek information and opinions, have a basic understanding of the role of individual actions, and are in the initial stages of forming their environmental attitudes. They are at the beginning of their environmental journey and are open to learning more about the complex nature of environmental issues and the actions needed to address them effectively.

Level 2: Application and Analysis.

The indicators shown by the respondents when answering the Level 2 questions are high, which indicates a high level of competence formation in all groups:

Group 1 (18–30 years old): 11.

Group 2 (31–45 years old): 12.

Group 3 (46–54 years old): 12.

The indicators of competence formation at Level 2 include:

Application of environmental knowledge: Individuals at Level 2 show the ability to apply their knowledge of environmental issues to their daily lives and decision-making processes. They can connect their understanding of concepts such as resource conservation, waste reduction, or sustainable consumption to their behavior and make conscious choices that align with their environmental values. Level 2 individuals may consider the

environmental impact when purchasing products, using resources, or engaging in activities to minimize their negative ecological footprint;

Analysis of personal behavior: Individuals at Level 2 possess the capacity to analyze their own behavior and assess its impact on the environment. They are able to evaluate their energy consumption, waste generation, transportation choices, or other practices and identify areas for improvement. Level 2 individuals may use tools such as carbon footprint calculators, energy audits, or waste tracking methods to gain a better understanding of their environmental impact and make informed decisions based on these insights;

Research and analysis: Level 2 individuals demonstrate proficiency in researching and analyzing environmental topics. They can gather information from a variety of sources, such as scientific articles, reports, or credible websites, and use critical thinking skills to understand complex environmental issues. Level 2 individuals are capable of identifying patterns, recognizing cause–effect relationships, and drawing evidence-based conclusions;

Consideration of long-term consequences: Individuals at Level 2 show an awareness of the long-term consequences of their actions on the environment. They understand that individual choices can have far-reaching impacts on ecosystems, climate, or natural resources. Level 2 individuals consider the long-term effects of their behavior and strive to make choices that promote sustainability and environmental stewardship;

Appreciation of biodiversity: Individuals at Level 2 have an appreciation for biodiversity and its importance for ecological balance and human well-being. They recognize the value of diverse ecosystems, species, and genetic resources, and understand the threats posed by factors such as habitat loss, pollution, or climate change. Level 2 individuals may actively support conservation efforts, educate others about biodiversity, or advocate for policies and practices that protect and preserve natural diversity.

These indicators demonstrate competence formation in respondents at Level 2, focusing on the application of environmental knowledge, analysis of personal behavior, research and analysis skills, consideration of long-term consequences, and appreciation for biodiversity. Individuals at this level are actively engaging with environmental issues and demonstrating a growing understanding of their personal impact on the environment and the importance of sustainable practices.

Level 3: Reflection and Evaluation.

The indicators shown by the respondents when answering the Level 3 questions are a high (Group 1) and an average level (Group 2, Group 3) of maturity of competence, which indicates a high level of competence formation in all groups:

Group 1 (18–30 years old): 10.

Group 2 (31–45 years old): 9.

Group 3 (46–54 years old): 7.

The indicators of competence formation at this level include:

Self-reflection on personal behaviors: Individuals at Level 3 demonstrate the ability to critically reflect on their behaviors and their impact on the environment. They exhibit self-awareness and a willingness to assess their actions and make changes to reduce their environmental footprint. Level 3 individuals may assess their energy consumption, waste generation, transportation choices, or dietary habits, among others, and actively seek ways to minimize their negative environmental impact;

Evaluation of environmental information: Individuals at Level 3 possess the ability to evaluate information related to environmental issues critically. They can distinguish between credible sources and misinformation, identify biases, and consider multiple perspectives when seeking information or forming opinions about environmental problems. Level 3 individuals engage in fact-checking and critical analysis to make informed decisions and support their environmental awareness and activism;

Curiosity about global environmental challenges: Level 3 individuals exhibit curiosity and a genuine interest in global environmental challenges. They actively seek out information, stay updated with current environmental issues, and pursue opportunities to learn and educate themselves about various environmental topics, including climate change,

biodiversity loss, pollution, or sustainable development. They may engage in self-directed learning, attend workshops or conferences, or participate in online courses to deepen their knowledge;

Understanding underlying causes of environmental problems: Individuals at Level 3 demonstrate an understanding of the underlying causes and systemic drivers of environmental problems. They go beyond surface-level understanding to analyze the root causes of issues such as climate change or habitat destruction, considering factors such as economic systems, policy frameworks, industrial practices, or cultural norms. Level 3 individuals recognize the importance of addressing these structural factors to achieve meaningful and long-lasting environmental change.

These indicators showcase competence formation in respondents at Level 3, emphasizing the ability to reflect on personal behaviors, evaluate environmental information critically, demonstrate curiosity about global environmental challenges, and possess an understanding of the underlying causes of environmental problems. Individuals at this level show a commitment to personal growth and an understanding of the complexity and interconnectedness of environmental challenges.

Level 4: Integration and Synthesis.

The indicators shown by the respondents when answering the Level 4 questions are an average level of maturity of competence, which indicates a high level of competence formation in all groups:

Group 1 (18–30 years old): 8.

Group 2 (31–45 years old): 7.

Group 3 (46–54 years old): 7.

The indicators of competence formation at this level include:

Demonstrating a comprehensive understanding of climate change and its impacts: Individuals at Level 4 possess a deep understanding of the causes, consequences, and systemic impacts of climate change. They can articulate and explain complex concepts related to climate change, including its scientific basis, social and economic implications, and potential solutions;

Active involvement in environmental advocacy or activism: Level 4 individuals actively engage in environmental advocacy or activism efforts. They demonstrate a commitment to addressing environmental challenges through actions such as participating in protests, organizing campaigns, promoting sustainable practices, or collaborating with environmental organizations;

Effective communication skills regarding environmental issues: Individuals at Level 4 excel in communicating environmental issues to diverse audiences. They demonstrate the ability to convey complex information in a clear and accessible manner, tailoring their messages to effectively engage and inform different stakeholders. Level 4 individuals may use various communication channels, such as public speaking, writing, social media, or multimedia platforms, to raise awareness and foster understanding of environmental challenges;

Application of sustainable design or planning principles: Level 4 individuals demonstrate the ability to apply sustainable design or planning principles in practical contexts. They can analyze and evaluate the environmental impact of different design or planning choices, taking into consideration factors such as resource efficiency, waste reduction, renewable energy integration, and biodiversity conservation. They actively seek sustainable solutions and approaches that minimize negative environmental impacts while promoting social and economic well-being;

Integration and synthesis of diverse knowledge and experiences: Individuals at Level 4 possess the capability to integrate and synthesize knowledge and experiences from various disciplines and sources related to environmental issues. They can connect different perspectives and insights, allowing for a holistic understanding of environmental challenges and their interconnections with social, economic, and political factors. Level 4 individuals

can effectively combine information and experiences to develop innovative and integrated approaches to address complex environmental problems.

These indicators demonstrate competence formation in respondents at Level 4, showcasing a strong grasp of climate change, active engagement in environmental advocacy, effective communication skills, application of sustainable design or planning principles, and the ability to integrate and synthesize diverse knowledge and experiences related to environmental issues.

Level 5: Advanced Analysis and Application.

The indicators shown by the respondents when answering the Level 5 questions are a high level of maturity of competence, which indicates a high level of competence formation in all groups:

Group 1 (18–30 years old): 14.

Group 2 (31–45 years old): 13.

Group 3 (46–54 years old): 14.

The values that indicate competence formation at Level 5 include:

Extensive integration of environmental considerations into decision-making processes: This indicates that individuals at Level 5 possess the ability to effectively incorporate environmental factors into their decision-making, showcasing a high level of competence in considering environmental sustainability in various contexts;

Strong belief in the importance of critical thinking: Level 5 individuals understand and recognize the significance of critical thinking skills for addressing complex environmental challenges. They have a firm conviction that critical thinking plays a crucial role in effectively tackling the multifaceted nature of environmental issues;

Comprehensive understanding of critical thinking principles: Individuals at Level 5 have a deep understanding of critical thinking and its various facets as they apply to addressing complex environmental challenges. They demonstrate knowledge and mastery of skills such as analyzing and evaluating evidence, applying logical reasoning, questioning assumptions and biases, and considering multiple perspectives;

Recognition of critical thinking's role in promoting environmental awareness and education: Level 5 individuals understand the potential impact of critical thinking on environmental education. They recognize that critical thinking skills can encourage curiosity and inquiry about environmental issues, foster a deeper understanding of ecosystems' interconnectedness, empower individuals to critically evaluate environmental information, and equip students with problem-solving skills to tackle environmental challenges;

Ability to provide diverse examples of critical thinking in action: Individuals at Level 5 can offer a wide range of examples that demonstrate how critical thinking can contribute to finding innovative solutions for environmental issues. These examples may include generating ideas for sustainable practices, applying systems thinking to address climate change, evaluating the effectiveness of renewable energy technologies, and analyzing the social and economic impacts of environmental policies.

Understanding of how critical thinking can enhance students' understanding of environmental concepts: Level 5 individuals recognize that critical thinking can support students' comprehension of environmental concepts. They understand that critical thinking involves challenging preconceived notions and misconceptions, promoting self-reflection and self-directed learning, and facilitating a deeper understanding of environmental concepts.

These values indicate in respondents the formation of competence at Level 5, showcasing advanced analytical skills and the ability to effectively apply critical thinking to address complex environmental challenges.

4. Discussion

The analysis reveals that cultivating a culture of critical thinking plays a pivotal role in nurturing an environmentally conscious society. Individuals who possess critical thinking skills are better equipped to analyze and evaluate information from multiple perspectives.

This ability enables them to understand the complex causes and effects of environmental problems, as well as the interconnections within ecological systems. In order to meet new challenges and ensure sustainable development, it is important to establish clear boundaries and ethical standards. The establishment of ethical boundaries allows for the consideration of the effects of decision-making on human rights, social equality, and environmental conservation [77–79]. This promotes more sustainable outcomes. This idea involves recognizing the interconnectedness of economic, environmental, and social factors. By defining boundaries, ethical considerations can be integrated into decision-making processes, ensuring that solutions not only solve immediate problems but also align with ethical principles. This fosters fairness, justice, and the well-being of both present and future generations.

Achieving sustainable development requires collaboration among a range of stakeholders, including governments, businesses, communities, and individuals. Establishing boundaries provides a framework for engaging these stakeholders in discussions and decision-making that prioritize ethical concerns. This participatory approach promotes inclusivity, transparency, and accountability, ultimately leading to more effective and sustainable solutions.

Sustainability demands that we consider the long-term impacts of our choices. Ethical boundaries enable us to evaluate the potential effects of our decisions on various dimensions, such as human rights, social equality, and environmental preservation. This comprehensive approach helps prevent trade-offs and unintended negative consequences, resulting in more sustainable outcomes.

Additionally, critical thinking empowers individuals to critically evaluate environmental information, enabling them to discern reliable sources from misinformation. Given the prevalence of biased narratives and misinformation in the digital age, this discerning ability is of paramount importance. By critically analyzing information, individuals can make informed decisions and avoid perpetuating false narratives that hinder environmental progress. Moreover, critical thinking prompts individuals to engage in reflective behaviors, allowing them to assess their actions and evaluate their environmental impact. This process facilitates responsible decision-making and empowers individuals to adopt sustainable practices that minimize their ecological footprint. By continually seeking knowledge and staying informed about global environmental challenges, critical thinkers become active participants in tackling environmental problems.

Through the Ecological Culture Model in Educational Disciplines, society can cultivate a culture of critical thinking that leads to sustainable practices, responsible decision-making, and heightened awareness of collective responsibility toward environmental protection and preservation. By integrating critical thinking skills into educational curricula and fostering a mindset that values objective analysis, information evaluation, reflective behaviors, and self-directed learning, individuals will be empowered to address environmental challenges effectively.

The global drive for sustainable development and environmental preservation has underscored the need for critical thinking capabilities within society [80]. Cultivating a culture of critical thinking can empower individuals to engage in responsible decision-making and adopt sustainable practices that effectively address pressing environmental issues. The Ecological Culture Model in Educational Disciplines (Table 1) presents a structured approach to integrating critical thinking into educational disciplines, promoting a heightened awareness of collective responsibility toward environmental stewardship.

Thus, critical thinking serves as the thread that weaves through each level of the ecological culture model. It encourages individuals to question existing norms, challenge assumptions, and delve deeper into complex environmental issues. Critical thinking empowers individuals to analyze information critically, evaluate competing perspectives, and make informed decisions based on evidence.

Table 1. The ecological culture model in educational disciplines.

N	Ecological Culture Level	Content	The Role of Critical Thinking
1.	Formation of environmental literacy	At the foundation of the model lies the development of environmental literacy among individuals. This level involves acquiring knowledge about ecological concepts, resource conservation, biodiversity, and the interrelationships between humans and the environment. It is represented by a square labeled "Environmental Literacy".	While acquiring environmental literacy, individuals can be encouraged to question the sources of information, recognize biases, and evaluate the credibility of scientific research.
2.	Mastering functional environmental literacy	Building upon the foundational knowledge, individuals progress to the application of environmental knowledge in their everyday lives. This level entails adopting eco-oriented practices such as waste reduction, energy conservation, water preservation, and sustainable consumption. Represented by a square labeled "Functional Environmental Literacy", this level emphasizes practical implementation.	Mastering functional environmental literacy involves critical thinking by questioning consumption patterns, identifying alternatives, and critically evaluating the impact of our daily choices on the environment.
3.	Formation of ethno-cultural literacy	Recognizing the importance of cultural and sociocultural aspects of the environment, individuals advance to this level. Here, they appreciate the role of traditions, indigenous knowledge, and cultural practices in environmental preservation. This level encourages the understanding that diverse cultures have unique relationships with their ecosystems. It is depicted by a square labeled "Ethno-Cultural Literacy".	Developing ethnocultural literacy with critical thinking involves challenging cultural norms that may contribute to environmental degradation, fostering an open dialogue about sustainable practices across cultures, and appreciating diverse perspectives on environmental stewardship.
4.	Formation of experience in making environmentally oriented decisions	At this stage, individuals gain practical experience in making environmentally conscious decisions. They consider the ecological consequences of their actions and actively seek out environmentally friendly alternatives. This level is represented by a square labeled "Environmentally Oriented Decisions".	Critical thinking plays a key role in making environmentally oriented decisions by analyzing complex environmental issues, evaluating the effectiveness of proposed solutions, and considering unintended consequences.
5.	Formation of experience in professional eco-oriented decisions	From personal choices, individuals extend their environmentally oriented decision-making to their professional realms. Whether in environmental sciences, engineering, urban planning, policy-making, or other fields, they actively contribute to sustainability efforts in their careers. This level, represented by a square labeled "Professional Eco-Oriented Decisions", highlights the role of professionals in driving systemic change.	In professional eco-oriented decisions, critical thinking enables individuals to interpret scientific data, assess the viability of sustainable technologies, and critically evaluate policies to ensure their alignment with ecological principles.

Table 1. *Cont.*

N	Ecological Culture Level	Content	The Role of Critical Thinking
6.	Formation and Development of Ecological Thinking	At this stage, individuals develop a holistic and systemic understanding of ecological issues. They critically analyze complex environmental problems, consider multiple perspectives, and identify root causes. This level fosters the ability to think long-term, anticipate consequences, and propose sustainable solutions. It is depicted by a circle labeled "Ecological Thinking".	Ecological thinking itself is inherently rooted in critical thinking. It involves analyzing complex systems, understanding feedback loops, considering the interconnectedness of social, economic, and environmental factors, and critically evaluating the effectiveness of proposed solutions.
7.	Self-regulation of environmentally oriented behavior and lifestyle	The highest stage of the ecological culture model involves individuals internalizing environmentally oriented actions as personal imperatives. They exhibit self-regulated behavior that aligns with environmental values and principles. Individuals become role models, advocates for sustainable living, and actively work to promote ecological culture in their communities. Represented by a circle labeled "Self-Regulation", this level embodies the pinnacle of ecological culture.	Self-regulation of environmentally-oriented behavior and lifestyle requires ongoing critical reflection, deepening personal values, and critically evaluating the impact of individual actions on a larger scale.

Note: compiled by the author.

The Ecological Culture Model in Educational Disciplines is a multifaceted approach that aims to foster a deep understanding and appreciation for the interconnections between humans and their natural environment [81,82]. Rooted in the principles of ecological thinking and sustainable development, this model envelops a comprehensive framework for transforming the traditional educational paradigm towards one that promotes ecological literacy, environmental stewardship, and societal transformation.

Drawing upon the ecological concept of interdependence and interconnectedness, the model recognizes that all living organisms, including humans, are inherently linked to one another and the larger web of life. By embracing this systemic perspective, the Ecological Culture Model in Educational Disciplines seeks to nurture a holistic understanding of human–nature relationships and inspire individuals to actively participate in the preservation and enhancement of the natural world.

At the core of this model lies the integration of ecological knowledge into all aspects of education, transcending traditional disciplinary boundaries. By incorporating ecological principles, scientific insights, and real-world examples, people are encouraged to explore the intricate dynamics of ecosystems, examine the consequences of human actions on the environment, and develop a sense of responsibility towards the planet. This interdisciplinary approach empowers people to grasp the complex environmental challenges facing our society and equips them with the knowledge and skills necessary to address these challenges in an informed and sustainable manner.

Furthermore, the Ecological Culture Model in Educational Disciplines acknowledges the significance of cultivating a shared cultural ethic that values ecological integrity, social justice, and equity. It recognizes that environmental problems are not isolated issues, but rather, interconnected with social, economic, and cultural factors. Consequently, this model emphasizes the need for an inclusive and participatory approach, where diverse perspectives and voices are acknowledged and respected. By fostering dialogue, critical thinking, and collaborative problem-solving, the model aims to cultivate a sense of belonging and shared responsibility among people, encouraging them to become active agents of change in creating a sustainable and just society.

One way to introduce ecological culture into academic disciplines is by incorporating elements of it into courses that focus on critical thinking, such as logic. This project aims to investigate the impact of tasks and activities that promote ecological awareness, critical thinking, and sustainability, in order to encourage a more ecologically-minded student body. The objectives of this investigation are to:

- Assess the current state of integration of ecological culture in the discipline of logic and identify areas for improvement;
- Develop and test tasks and activities that promote ecological culture in the discipline of logic and other selected academic disciplines;
- Measure the effect of these tasks on students' ecological awareness, critical thinking skills, and environmentally responsible behavior;
- Explore the potential benefits and challenges of interdisciplinary collaboration in enhancing ecological culture in academic disciplines.

Through this study, a series of tasks and activities will be developed that integrate ecological culture into the discipline of logic. These tasks might include case studies, problem-solving scenarios, debates, and ethical dilemmas that necessitate critical thinking and consideration of environmental impact.

This research project contributes to existing knowledge by providing insights into the integration of ecological culture in the discipline of logic and other disciplines. The findings will help develop effective tasks and activities that increase ecological awareness and critical thinking skills in students, fostering a more sustainable and environmentally conscious academic community. By investigating the integration of ecological culture in the discipline of logic and other academic disciplines, this research project seeks to bridge the gap between environmental consciousness and critical thinking skills.

5. Conclusions

The findings of the sociological survey conducted in Yekaterinburg City indicate a significant level of ownership and shared responsibility among residents, highlighting their active engagement as catalysts for positive change in fostering a sustainable and equitable society. The study emphasizes the importance of critical thinking skills in equipping individuals with the necessary competencies to address complex environmental challenges.

By exploring the relationship between critical thinking and sustainable practices, it becomes evident that critical thinking abilities are instrumental in creating a solid foundation for a sustainable future. These skills enable individuals to analyze and evaluate information, make informed decisions, and adopt responsible behaviors that contribute to the preservation of the environment.

Critical thinking is crucial for promoting an environmentally conscious society. It allows individuals to evaluate information from multiple angles, differentiate between reliable sources and misinformation, and make responsible decisions that minimize their ecological footprint. To cultivate a culture of critical thinking, society can adopt the Ecological Culture Model in Educational Disciplines by integrating critical thinking skills into curricula and promoting a mindset that values objective analysis, information evaluation, reflective behaviors, and self-directed learning. This approach empowers individuals to effectively address environmental challenges and promotes collective responsibility toward environmental stewardship.

Drawing upon the proposed model of ecological culture in academic disciplines, this article presents a structured approach to raising environmental awareness within academic contexts. Integrating critical thinking into various academic disciplines not only enhances students' ability to critically analyze environmental issues but also promotes cross-disciplinary collaboration in tackling these challenges. The study highlights the significance of integrating critical thinking into educational frameworks, urging policymakers and educators to prioritize the development of critical thinking skills among students. By fostering a culture of critical thinking, educational institutions can empower individuals to become active participants in creating a sustainable and equitable society.

The importance of the results obtained for practical education lies in the potential to inform and shape future research, policy implementation, and community engagement efforts in the realm of environmental culture and critical thinking. Based on the results of this study, several potential directions can be suggested.

The findings can inform policy initiatives at various levels, such as educational institutions, local governments, and national bodies. Policies can focus on integrating critical thinking skills into environmental education curricula, promoting interdisciplinary approaches, fostering collaboration between academia and relevant stakeholders, and supporting initiatives that encourage active participation and shared responsibility for environmental sustainability.

The study highlights the importance of residents' involvement and shared responsibility in building a sustainable future. Community engagement efforts can be directed toward raising awareness about environmental issues, enhancing critical thinking skills, and promoting sustainable practices at the individual and collective levels.

The study suggests a structured approach to integrating critical thinking and environmental awareness into academic disciplines. This model can serve as a guide for curriculum developers and educators to design educational materials, teaching methods, and assessment tools that foster critical thinking skills and ecological culture across various subjects. It emphasizes the importance of interdisciplinary learning, problem-solving, and the application of knowledge in real-world contexts.

There are several limitations to be considered in this study. Firstly, the survey conducted in Yekaterinburg City is limited to a specific geographical location, which may limit the generalizability of the findings to other contexts. Therefore, caution should be exercised when applying the results beyond the study area.

Secondly, the sociological survey relied on self-report data, which are subject to response bias and potential inaccuracies. The respondents' answers may be influenced by social desirability bias or may not accurately reflect their true behaviors and attitudes. Future studies could consider using additional methods, such as observation or interviews, to supplement the self-report data.

Thirdly, the study focused primarily on the perceptions and behaviors of residents in Yekaterinburg City. It did not explore the perspectives of other stakeholders, such as policymakers, educators, or environmental organizations. Including these perspectives could provide a more comprehensive understanding of the various factors that influence the development of an ecological culture.

Furthermore, this study primarily focused on the integration of critical thinking into academic disciplines. While academic institutions play a crucial role in promoting sustainable practices, other sectors, such as government and industry, also have a significant impact on environmental sustainability. Future research should consider examining the role of critical thinking in these sectors and exploring potential barriers and facilitators to its integration.

The study did not assess the long-term impact of integrating critical thinking into environmental education. Follow-up studies could examine the effectiveness and sustainability of such interventions over an extended period to assess whether the changes in attitudes and behaviors are maintained over time. Further research is needed to address these limitations and expand our understanding of how critical thinking can be effectively integrated into educational frameworks to foster an ecological culture and promote sustainable practices.

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Institutional Review Board Statement: This study followed the ethical principles of the Declaration of Helsinki in terms of confidentiality, anonymity, and use of information for research purposes only.

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Data Availability Statement: Not applicable.

Conflicts of Interest: The author declares no conflict of interest.

Appendix A

Examples of assigning numerical values to the responses are listed below.

In Level 1: Basic Understanding and Opinion Seeking, the value labels for the numeric parameters of the questions were as follows:

1. How much do you believe individual actions can contribute to solving environmental issues?
   (a) A great deal: high level (3 points);
   (b) Somewhat: medium level (2 points);
   (c) Not at all: low level (1 point).
2. Are you aware of the concept of sustainable development?
   (a) Yes, very well: high level (3 points);
   (b) To some extent: medium level (2 points);
   (c) No, not at all: low level (1 point).
3. How often do you seek out information on environmental topics?
   (a) Regularly: high level (3 points);
   (b) Occasionally: medium level (2 points);
   (c) Rarely or never: low level (1 point).
4. In your opinion, which of the following best represents a sustainable lifestyle?
   (a) Conserving energy and water resources: high level (3 points);
   (b) Reducing waste and recycling: medium level (2 points);
   (c) Using environmentally friendly products: low level (1 point).

In Level 2: Application and Analysis, the value labels for the numeric parameters of the questions were as follows:

5. How well do you understand the environmental impact of different consumer choices?
   (a) Very well: high level (3 points);
   (b) Moderately well: medium level (2 points);
   (c) Not very well: low level (1 point).
6. Have you ever conducted research or analysis on an environmental issue?
   (a) Yes, extensively: high level (3 points);
   (b) Yes, to some extent: medium level (2 points);
   (c) No: low level (1 point).
7. Do you consider the long-term consequences of your actions on the environment?
   (a) Always: high level (3 points);
   (b) Sometimes: medium level (2 points);
   (c) Rarely or never: low level (1 point).
8. How well do you understand the role of biodiversity in maintaining ecosystem health?
   (a) Very well: high level (3 points);
   (b) Moderately well: medium level (2 points);
   (c) Not very well: low level (1 point).

In Level 3: Reflection and Evaluation, the value labels for the numeric parameters of the questions were as follows:

9. Have you ever changed your habits or lifestyle to reduce your environmental impact?
   (a) Yes, significantly: high level (3 points);
   (b) Yes, to some extent: medium level (2 points);
   (c) No: low level (1 point).

10. How often do you critically evaluate the sources and credibility of environmental information you come across?
    (a) Always: high level (3 points);
    (b) Sometimes: medium level (2 points);
    (c) Rarely or never: low level (1 point).
11. How interested are you in learning about the environmental challenges faced by different regions of the world?
    (a) Very interested: high level (3 points);
    (b) Moderately interested: medium level (2 points);
    (c) Not very interested: low level (1 point).
12. Do you think critical thinking helps in understanding the underlying causes and root issues of environmental problems?
    (a) Definitely: high level (3 points);
    (b) Possibly: medium level (2 points);
    (c) Not really: low level (1 point).

In Level 4: Integration and Synthesis, the value labels for the numeric parameters of the questions were as follows:

13. How well do you understand the concepts of climate change and its impacts?
    (a) Very well: high level (3 points);
    (b) Moderately well: medium level (2 points);
    (c) Not very well: low level (1 point).
14. Have you ever taken part in environmental advocacy or activism?
    (a) Yes, extensively: high level (3 points);
    (b) Yes, to some extent: medium level (2 points);
    (c) No: Low level (1 point).
15. How confident are you in your ability to communicate environmental issues effectively to others?
    (a) Very confident: high level (3 points);
    (b) Moderately confident: medium level (2 points);
    (c) Not confident: low level (1 point).
16. Have you ever applied principles of sustainable design or planning in your personal or professional projects?
    (a) Yes, extensively: high level (3 points);
    (b) Yes, to some extent: medium level (2 points);
    (c) No: low level (1 point).

In Level 5: Advanced Analysis and Application, the numerical parameters for the answers were as follows:

17. How do you define critical thinking in addressing complex environmental challenges?
    (a) Analyzing and evaluating evidence to form informed opinions: high level (3 points);
    (b) Applying logical reasoning to solve environmental problems: medium level (2 points);
    (c) Questioning assumptions and biases to gain deeper insights: medium level (2 points);
    (d) Considering multiple perspectives to make well-rounded decisions: high level (3 points);
    (e) I did not apply critical thinking to complex environmental problems: low level (1 point).

18. In your opinion, what role does critical thinking play in promoting environmental awareness and education?
    (a) Encouraging curiosity and inquiry about environmental issues: medium level (2 points);
    (b) Fostering a deeper understanding of the interconnectedness of ecosystems: high level (3 points);
    (c) Empowering individuals to evaluate environmental information critically: high level (3 points);
    (d) Equipping students with problem-solving skills to tackle environmental challenges: high level (3 points);
    (e) Critical thinking plays no role in promoting environmental awareness and education: low level (1 point).
19. Can you provide examples of how critical thinking can contribute to finding innovative solutions for environmental issues?
    (a) Generating ideas for sustainable practices in waste management: medium level (2 points);
    (b) Applying systems thinking to address climate change adaptation: high level (3 points);
    (c) Evaluating the effectiveness of renewable energy technologies: medium level (2 points);
    (d) Analyzing the social and economic impacts of environmental policies: high level (3 points);
    (e) No: low level (1 point).
20. How do you think critical thinking skills can enhance students' understanding of environmental concepts?
    (a) Challenging preconceived notions and misconceptions about the environment: high level (3 points);
    (b) Promoting self-reflection and self-directed learning in environmental studies: medium level (2 points);
    (c) Encouraging independent research and analysis of environmental topics: high level (3 points);
    (d) Developing the ability to make connections between environmental factors: high level (3 points);
    (e) Critical thinking skills cannot improve students' understanding of environmental concepts: low level (1 point).
21. To determine the formation of the level when answering question 21 of the Level 5 questionnaire, the numerical parameters were assigned as follows:
    (a) Yes, individuals critically assessed the feasibility of a local recycling program: high level (3 points);
    (b) Yes, communities used critical thinking to identify the root causes of pollution: high level (3 points);
    (c) Yes, individuals applied critical thinking to evaluate the impact of deforestation: high level (3 points);
    (d) No, I have not observed any specific instances of critical thinking in this context: low level (1 point).

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