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The Effects of Using a Case Study Method for Environmental Education

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Abstract. The purpose of the study was to do a comparative analysis of the quality of the case study method for developing practical skills related to environmentally friendly behavior that is in line with the professional orientations of two student groups of different non-environmental specialties. Research methods included an ascertaining and forming experiment; questionnaires with open and closed questions; project modeling; collection and mathematical and statistical evaluation of empirical data; graphic methods of statistical data processing; comparative analysis of the findings; functional analysis of empirical data; analysis of causal relationships; and generalization and forecasting. According to the results of secondary diagnostics that involved the distribution of students by zones of success, revealed a significant increase in indicators of activity-behavioral aspects of professionally oriented environmental education. In Group I, 3.1% of students were in the area of undesirable indicators, and in Group II, it was 4.0%. The neutral area with confused tendencies was occupied by 33.8% of students of Group I, and 20.3% of Group II. The targeted area of clearly positive dynamics involved 63.1% of Group I, and of Group II, 75.7%. Further enquiry into the research issue should relate to enhancing the case study method in the framework of environmental education.

Keywords: environmental education; eco-culture; tertiary education; primary school; case study method

1. Introduction

Environmental education is an important area of didactics. Environmental education is conceptualized in light of the transformation of worldviews, from anthropocene-dominant, to that categorized in the paradigm of the innovative concept of planetary and global thinking (Rosa, 2017). The holistic direction of sustainable development, which has now been adopted by all developed countries, and which covers all spheres of human life, creates a foundation for adopting the principles of environmental education, not only for environmental professionals specifically, but also for globalized social spaces (Gevorgyan & Adanalyan, 2009; Podgaysky et al., 2015).

It is worth remembering that sustainable development issues are given sufficient attention in the management and policy guidelines of leading international organizations. Suffice it to say that the UN declared the decade of 2005–2014 as the Decade of Education for Sustainable Development (Buckler & Creech, 2014), with the aim of integrating basic theoretical principles and practical achievements in the field of sustainable development for all areas and at all levels of education. In particular, the point under discussion is the green economy and other measures to improve human well-being by reducing environmental risks and ecological scarcities. At the global level, these and other special events mainstream the need to care for natural resources and ensure conservation. This can be achieved only by consistently and systematically shaping environmental values, which could also be achieved through a system of environmental education. The motivation for such education is safeguarding the principles of ecological awareness and citizenship. However, there is less clarity about best practices and methods for teaching people about complex environmental problems (Pellaud et al., 2019).

So, the very concept of environmental education in the paradigm of modern discourses is generalized to the broader concept of education for sustainable development. These concepts are, correspondingly, also positioned as integral elements of Sustainable Development Goal (SDG) 4, which relates to quality education, and which is a key enabler of all other SDGs (European Commission, 2021).

Thus, the very value of environmental education today is axiomatic. However, the issue of productive formation of environmental safety as a value and principle in practice remains undefined, as there is little clarity about best practices and methods for teaching about complex environmental problems (Wei et al., 2018, p. 2). That said, as the generalized experience shows, the current state of forming values relating to ecology in the young generation raises doubts about the stability of the formation of value-motivational and behavioral aspects of environmental consciousness, and needs considerable attention (Chen, 2019; Hassim, 2021; Suchanek & Szmelter-Jarosz, 2019). The search for and generalization of effective methods for forming positive attitudes towards the environment, and environmentally safe behavior by pupils and students at all education levels is all the more relevant because the European Commission is currently working on a recommendation on education for environmental

sustainability for learners of all ages and at all levels of education. The official policy document is due in 2021 (European Commission, 2021). The basic points of emphasis discussed by the experts in the training process are environmental sustainability, climate education, biodiversity, and related topics. The already approved policy document on the prospects and plans for the implementation of Education for Sustainable Development after 2019, to 2030, is the relevant document adopted at the UNESCO 40th General Conference (UNESCO, 2019).

2. Literature Review

Since the practical side of the issue is still an urgent matter (Liu & Guo, 2018), the key priority is to find effective methods of teaching environmental education (Bakhtiar, 2016) –in both professional and non-professional general education. If, for environmentalists, the problems of the ecological plane are in the sphere of research and regulatory and executive interests, then, for non-ecologists, the issues of ecological education relate to mastering those norms of behavior, and forming suitable ideas about the world in general and the environment in which people live, thereby enabling quality socialization of the individual according to principles of tolerance, and encouraging non-harmful attitudes to natural resources. In particular, the Global Environmental Education Partnership (GEEP) (2021) discusses environmental education aimed at promoting positive youth development.

Given the essence of environmental education and the practical side of the issue, which requires a comprehensive description and specific solutions, a relatively innovative case study method is relevant and pragmatically substantiated. Case study is a desirable research method, or research framework, within a pedagogical niche (Dunst & Hamby, 2015; Yin, 2018). Hence, Wei et al. (2018) express the need to switch from a purely passive lecture model of teaching, to active learning, especially in the STEM fields (science, technology, engineering, and mathematics), where the field of ecology also belongs. Undoubtedly, the initial understanding of the case study method as a research method (Yin, 2018), and the innovative-experimental interpretation of case study according to the paradigm of the pedagogical process, and as a method of organizing the educational process, have much in common in terms of purpose, learning outcomes and implementation procedure. Case study methodology in the context of a pedagogical niche is associated with project-based learning (Al-Busaidi & Al-Seyabi, 2021).

Currently, two methodological types of case study are distinguished (Figure 1) – the Harvard type (Andersen & Schiano, 2014) and the Manchester type (Ridder, 2020).

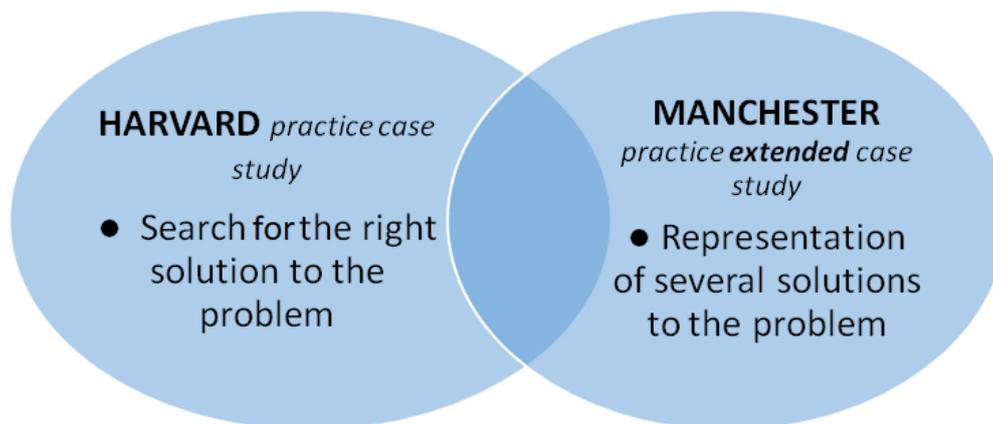


Figure 1. Methodological schools of case study

The procedure for applying the case study method in the process of professional and pedagogical training of future specialists will resemble a simplified model of a case study as a thorough study in the world of science. Cases for use in environmental education can be created on the basis of life experience, research results, training toolkits, guidelines on the level of ecological status in the selected region (production and environmental consequences, local environmental problems), scientific articles and monographs, statistics data, Internet resources, etc.

The case study method is considered to be rational and effective for implementing the content of environmental education (Mirghafoori et al., 2017; Tanik Önal, 2020). A case-study is described as a proactive approach to environmental issues. The case structure includes certain basic elements, as set out in Figure 2.

The range of factors influencing the formation of green behavior was evaluated, with the aim of elucidating the fundamental factors that determine human behavior as it relates to the environment. It was found that human green behavior is determined by environmental education and personal factors. Conversely, interpersonal and motivational factors are less influential ways of shaping this behavior. On the official website of the United States Environmental Protection Agency (n.d.), a special article is devoted to the essence of environmental education, with a statement that involves more than information about the environment. Good quality environmental education invariably teaches critical thinking and enhances individuals' problem-solving and decision-making skills.

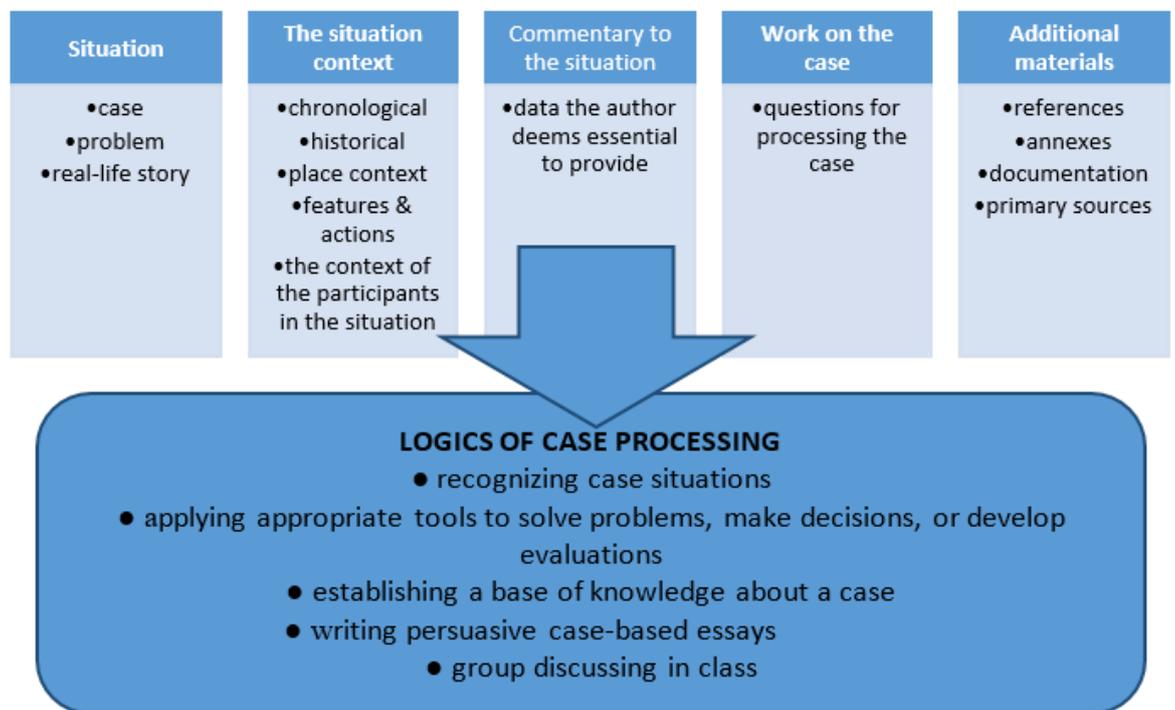


Figure 2: Typical case study structure, based on Ellet (2018)

In this context, the role of creating environmental awareness in school teachers, and ensuring they acquire environmental competencies, is becoming more important, and is conceptualized as continuous environmental education for teachers (Yachina et al., 2018). The key areas of environmental education that have great potential for implementation in the context of institutionalized education at all levels (from preschool to higher education), are (a) preservation of biodiversity, and (b) minimizing environmental pollution (Aznar-Díaz et al., 2019). Yachina et al. (2018) undertook a comparative study and found that students in regular classes have, by far, fewer established attitudes about environmental education than students in specialized environmental classes. The object of testing was primary school. A survey of teachers by Yachina et al. (2018) found that, in the organization of environmentally targeted educational work with students, teachers mostly use methods of a consultative nature, which prevents the formation of sustainable green ecology attitudes. These findings emphasize the urgent need to create special educational videos and interactive games to organize creative and exploratory work and to acquaint students with regional, national and global environmental agendas. In this regard, Boca and Saraçlı (2019) recommend that, in order to implement the principles of sustainable development, ecologically targeted educational activities should comprise multiple vectors, namely, education *for* the environment (lectures, good practice), education *in* the environment (trips, planting trees, cleaning water), education *about* the environment (sea disaster, storms, climate change), and education *to* (to sustain student's opinions, to respond to daily environmental problems, to express freely their personal ideas and opinions, to be involved in critical situations and to find proper solutions in limited situations) the environment. In environmental education activities, the primary

emphasis should be on the environment itself (Abdullah et al., 2018). Therefore, it is advisable to conduct the training in accordance with the principles of green ecology, through direct human interaction with the environment on the basis of tolerance, mutual enrichment, relevant use of natural resources and their transformation into products and means of human life with due regard to minimizing harmful effects.

In the framework of our study, we consider to be pertinent the work of Aznar-Díaz et al. (2019), which focuses on the issue of proper environmental training of future primary school teachers. The importance of testing students of pedagogical specialties in relation to the nature of their environmental attitudes is emphasized. Besides, there are benefits to organizing testing of the nature of environmental attitudes for certain large blocks by using different subscales, which are intended to address various issues of environmental protection. Positive indicators, in this case, will be not only linearly positive responses to the understanding and compliance in practice of environmentally friendly behavior and translation of eco-installations in the pedagogical space, but also the detection of positive interdependence among the different subscales.

Environmental education is realized only when the acquired theoretical knowledge is embodied in the logic and organization of actions that promote environmental protection. Therefore, the mechanisms of self-awareness, control, and proactiveness of the subjects in the education process are important. When students are at the stage of studying at university, they have gained a great deal of freedom and independence from their parents (which implies the actualization of their own environmental attitudes), and it becomes possible to fully check the level of the quality of their mastery of the principles of environmental education. In the context of university education, the role of student leadership is significant, as it is an effective tool for addressing environmental concerns and promoting environmental education (Ramirez, 2017).

The literature review on the topic of this study made it possible to identify promising areas of research, to validate the relevance of our study model, which involves a range of relevant concepts, and to probe and establish the connections that could bridge the gaps present in the application of various methods of case study in environmental education, and in particular, its practical perspective.

2.1. Purpose

The purpose of the study was to do a comparative analysis by applying the case study method to the development of practical skills relating to environmentally friendly behavior in line with the professional orientation of two student groups of different specialties, for whom environmental education was part of their professional training. Addressing the purpose included following this plan to approach the research tasks:

- 1) Studying the theoretical foundations of case study concepts and the main directions of developing environmental education, by drawing on the analysis of relevant scientific sources on the topic;
- 2) Elaborating on a research model and selecting experimental groups of respondents in different specialties, specifically with the guideline that, for both groups of students, environmental education involves, on the one hand, a basic attitude and skill needed for organizing current activities and, on the other, a component of the behavioral and competence aspects of a professional orientation;
- 3) Working out a training program for both groups, with an emphasis on a method for specific situations, and practically engaging the students in elaborating the environmental cases in the geographical area where they live;
- 4) Implementing all stages of the study and consolidating statistics;
- 5) Interpreting the results obtained and evaluating the trends identified in both groups, in accordance with the evaluation scale that had been devised; and
- 6) Summarizing the results, drawing conclusions and outlining prospects for further research into the application of the case study method in professionally targeted environmental education.

3. Material and Methods

General scientific, as well as special scientific methods were used in the process of performing the research tasks set. In particular, the special scientific methods were as follows:

- An ascertaining and formative experiment;
- Questionnaires with open and closed questions;
- Project modeling;
- Empirical data collection and mathematical and statistical evaluation;
- Graphical methods of statistical data processing;
- Comparative analysis of research results;
- Functional analysis of empirical data;
- Causal relationship analysis (summarizing the data, work materials and intermediate conclusions of the study, which had been built by experts in the form of an ishikawa diagram, creating an associative network; and obtaining intermediate conclusions by collective discussion technology and brainstorming); and
- The method of generalization and forecasting (while formulating the study findings and outlining promising areas of research in a relevant perspective).

The specific situations method – which a case study essentially is – involves a close interplay between previously acquired theoretical knowledge, and practice; in this way the line of experimental learning was built on the principle of active interaction with the environment in the area where the students lived and studied.

3.1. Participants

Two groups of respondents were enrolled to participate in the study. Quantitative and qualitative characteristics of both groups are presented in Table 1.

Table 1: Groups of respondents for case study method testing

	Group I	Group II
No. of respondents	70 participants	
	32 students	38 students
Year of study	IV - 4 th year students	
Affiliation	Faculty of Natural and Physical and Chemical Education of Oleksandr Dovzhenko Hlukhiv National Pedagogical University	Faculty of Preschool, Primary Education and Arts named after Valentyna Voloshyna of Vinnytsia Mykhailo Kotsyubynsky State Pedagogical University
Specialty	014 Secondary Education (Biology and human health)	013 Primary Education
	Bachelor education level	

The participants in both groups were selected randomly, without taking into account any special selection criteria for academic performance, social and scientific activities, etc. Fourth-year students were enrolled for the experiment for both groups, because it is expected that, by the last year of study for the education qualification level of Bachelor, students have gained the set of personal and professional qualities necessary for professional activities. This means that the assessment results of the experimental activities of these students would make it possible to draw conclusions about the relevance and level of the organization of education strategies at the university and, in particular, within the faculty from which participants had been selected for the study.

The choice of specialties was determined by the principles of expediency and competence. Environmental education, in the context of modern natural disasters caused by millennia of expansive human activities that are detrimental to the natural environment, is crucial for any niche specialist, as well as for any individual, from the earliest stages of conscious experience (which is why environmental education must be implemented from the stage of preschool education already).

Environmental education for concerned citizens and socially active individuals is conceptualized within the realm of soft skills. However, for a number of specialties, environmental education is a component of the spectrum of hard skills, i.e., it is a fundamental professional competency; this was the case for the groups of respondents formed for our research. For biology students, environmental education is a basic discipline, which is also a priority subject that concerns research and the professional concept. For future primary school teachers, environmental education is in the field of hard skills, which are indispensable for various reasons, such as (a) Acquiring theoretical knowledge and developing practical pedagogical skills for teaching natural sciences,

including that for the subject, "Exploring the World" (Grades 1–4); (b) Implementing the principles of sustainable education; and (c) Practical realization of the educational purpose of learning according to the principle of setting a good example.

For the research into selected educational and content markers for biology students, and methodological markers of environmental education for future primary school teachers at the 4th stage of the experimental part (see Table 2), biology students had to perform a Individual Research Region-Targeted Project; future primary school teachers did the Region-Targeted Advanced Environmental Education Methodological Project (for primary school pupils).

3.2. Stages of the Experiment

The process of preparing, implementing and summarizing the results of the experiment covered the period September 2020 to April 2021. Now and then, certain difficulties related to quarantine restrictions (introduced by the government due to the COVID-19 pandemic) arose, but the blended learning regime project did not deviate significantly from the planned dynamics and, accordingly, it was possible to implement the project to the full extent. The individual stages of the study logics are laid out in Table 2.

Table 2: Logics of conducting the experiment

Number of the Stage and Duration	Work Algorithm Description		Assessment Description
	Group I	Group II	
<i>Preliminary diagnostics</i>			
Stage 1/ First week	Environmental Awareness Quiz (CSCS, n.d.) (Appendix A, see https://drive.google.com/file/d/1sU2nInrVHT4JPF8YBIK6QMVgGribDDx5/view?usp=sharing)		50 points The main purpose was not to determine the overall summary indicator, but rather the relationship between the Environmental Awareness Test and the Environmental Safety Behavior Test – the relationship of theory to practice, abstract ideas about environmental trends and sustainable attitudes and behaviors.
Stage 2/ Second week	Environmental Safety Behavior Quiz (partially based on Petty (2014)). (Appendix B, see https://drive.google.com/file/d/1luz61IMQOJh_HQn6_Mb23Rn6SmF6Y0w0/view?usp=sharing)		50 points
<i>Secondary diagnostics (after implementing the special environmental education with active case study method</i> 4 th Week of September 2019–May 2020			
Stage 3/ September 2020–April 2021	Implementation of group environmental project		50 points Total 100 The secondary diagnostics stage included the implementation and relevant evaluation of group and individual work. In Stage 3, group success in the project case study was taken into consideration. Overall,

				though, success relied on the coordinated and successful work of each team member. However, in Stage 4 of the experiment, the emphasis was on individual achievements and, by analogy, the average result at the group level, was essential for evaluation.
<i>Specialty-oriented assignment</i>				
Stage 4/ September 2020–April 2021	Individual Research Region- Targeted Project	Region- Targeted Advanced Environmental Education Methodological Project (for primary school pupils)	50 points	

3.2.1. Preliminary Diagnostics

The two initial stages were the stages of preliminary diagnosis, which determined the dominant ideas of Stages 3 and 4. Therefore, in fact, about 1–2 weeks of preparation passed after Stages 1–2 and before the implementation of the course that involved case study application.

Special environmental education with active case study method implementation

For future primary school teachers, the case study involved teaching of the course "Introduction to Science", and for biology students, the course "Biogeography and Nature Protection".

The specific situations method was implemented, and engaged the participants in activities such as the following:

- Monitoring the ecological situation in Ukraine and worldwide, studying highly publicized situations, analyzing events and determining perspectives;
- Monitoring the ecological situation in different regions, drawing up maps to distinguish the places and positions that call for immediate environmental decisions;
- Cooperating with relevant departments of the City Council;
- Students and teachers keeping individual journals of ecological activity, followed by a monthly group discussion;
- Group and individual analysis of hypothetical ecological cases (see examples in Appendix C, https://drive.google.com/file/d/1luz61imqojh_hqn6_Mb23Rn6SmF6Y0w0/view?Usp=sharing);
- Arranging environment-related events at the local level (for example, flash mob "day without plastic", workshop on "Eco-safe behavior", various activities dedicated to Earth Day, etc.).

The work on the case (Appendix C, https://drive.google.com/file/d/1luz61imqojh_hqn6_Mb23Rn6SmF6Y0w0/view?Usp=sharing) included stages such as

- Integration into the situation (collection and generalization of brief theoretical information and factual statistical data);
- Description (model) of the situation;
- Drawing up a plan – developing questions and tasks for case study;
- In the case of organizing joint activities (group case study):
 - a. Collection of additional information;
 - b. Discussion of the case situation and adoption of possible solutions; and
 - c. Analysis and reflection on joint activities (presentation and discussion of results), discussion.

The technique of working with case studies was mostly based on a mixed method approach (Harvard and Manchester schools – see Figure 1): students were always required to find, not one, but a range of possible solutions, while the teacher's facilitated activities. However, after a discussion of all possible options, preference was given to one or two options with the greatest potential, with an explanation of what exactly justifies their exclusivity and greater effectiveness.

3.2.2. Secondary Diagnostics

In accordance with the principles of practicality and direct interaction with the environment, the synthesis of individual and group approaches to understanding environmental accountability, and environmentally beneficial and safe operation, Stage 3 involved the implementation of a group environmental project.

To execute this stage, respondents were divided into several subgroups of 5–6 participants each (Group I: 6 subgroups; Group II: 7 subgroups). Each subgroup elected a leader. Each subgroup was randomly assigned a practical environmental project on a regional scale. In general, the work included areas of activity such as the following:

- Streamlining the city's park fund: 2–3 groups of participants were expected to work in large city parks, with due regard to each park's territorial location, so that, after the experimental part, it would be possible to assess the effectiveness of each team. Work descriptions were provided, and students had to clean the park, improve and ameliorate the territory, cultivate and handle decorative flowers and plants, and service the park infrastructure.
- Work with ponds and surrounding area: the logic of work was similar to parks servicing.

Each subgroup had to present to the assigned supervisor a work plan and, then, regularly report on the progress of its implementation. Given that parks and squares, as well as reservoirs and adjacent territories, are recreational places for

city residents, environmental education events were also organized, which primarily engaged the youth and children.

Table 2 shows that, in practice, in accordance with the peculiarities of educational and professional activities of students of both groups, the case study method was synergized with project-based learning. Doing so enabled not only maximum hands-on interaction with the environment, and practicing a number of practical environmental education skills, but also shaping a creative and exploratory approach to perceiving the social perspective of environmental education.

In Stage 4, it was envisaged that respondents would be assigned tasks that were differentiated according to their specialties. For biology students, this was the Individual Research Region-Targeted Project, and for future primary school teachers, the Region-Targeted Advanced Environmental Education Methodological Project (for primary school pupils). Research topics were approved by scientific supervisors and guideline developers.

For biologists (Group I) the emphasis was on the scientific and practical parts of the problem. The directions encompassed the thematic field, from a search for effective methods of promoting an "eco" lifestyle, to developing practical, step-by-step guidelines to minimize the harmful effects of humans on the ecosystem of the city and suburbs, where respondents were able to localize their projects.

For future primary school teachers (Group II), the emphasis was on finding ways to organize environmental education for primary school students. Projects had to be presented in theoretical and practical forms. Respondents in Group II also had the opportunity to test the effectiveness of research findings and creative work during school internships. Therefore, theoretical methodological ideas on eco-learning through direct interaction with students in the process of carrying out joint environmental projects were implemented practically. In particular, while engaging in activities such as preparing educational video projects to promote the eco-style; cleaning and upgrading school grounds; producing birdhouses and feeders; designing school gardens and orchards (projects in the style of a 'school mini-farm'); committing to avoiding using plastic goods (engaging the entire families of students, screening video reports and practical recommendations for replacing plastic with available eco-materials); manufacturing educational eco-toys for school needs and orphanages; sewing shoppers, etc.

3.3. Evaluation System

A success scale was developed to interpret the experimental data (Table 3).

Table 3. System for evaluating educational achievements with application of the case study method and foundations of project-based learning

Range of points	Success level	Assessment of development trends
0-29 points	Extremely low	Area of undesirable indicators
30-44 points	Low (Needs profound improvement)	
45-64 points	Sufficient	Neutral area with confused tendencies
65-74 points	Rather good	Targeted area of clearly positive dynamics
75-89 points	High	
90-100 points	Advanced	

4. Results

This section will reflect the results obtained according to the logic of the stages of the experimental research.

4.1. Preliminary Diagnostics

The results of the input diagnosis are summarized in Table 4. The results obtained are graphically presented in Figure 3.

Table 4: Results of the preliminary diagnostics implemented for Group I and Group II

Level of Success	Group I		Group II	
	N	%	N	%
<i>Environmental Awareness Quiz</i>				
Extremely low	0	0.0%	0	0.0%
Low	3	9.3%	4	10.5%
Sufficient	6	18.8%	9	23.7%
Rather good	9	28.1%	12	31.6%
High	8	25.0%	7	18.4%
Advanced	6	18.8%	6	15.8%
<i>Environmental Safety Behavior Quiz</i>				
Extremely low	1	3.0%	2	5.3%
Low	5	15.6%	5	13.1%
Sufficient	10	31.3%	12	31.6%
Rather good	8	25.0%	10	26.3%
High	5	15.6%	6	15.8%
Advanced	3	9.4%	3	7.9%

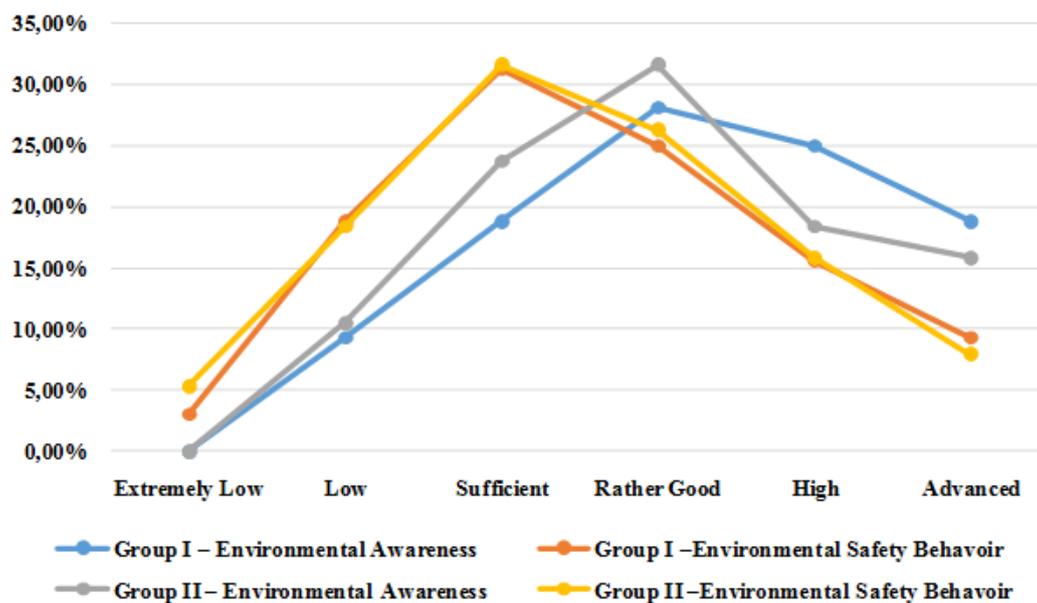


Figure 3: Results of preliminary diagnostics of both groups of respondents according to the indicators of Environmental Awareness and Environmental Safety Behavior

The results of comparative characteristics for Group I according to achievement categories on the Environmental Awareness Quiz indicate undesirable indicators in 9.3% of respondents, and in Group II, in 10.5% (with no results at Extremely Low in either group). Performance at the level of neutral development trend with confused tendencies was 18.8% for Group I, and 23.7% for Group II. The level of targeted area of clearly positive dynamics, was represented by 71.9% in Group I, and 65.8% in Group II. According to the results of the Environmental Safety Behavior Quiz, the area of undesirable indicators for Group I was 18.6%, and for Group II, 18.4%. Neutral area with confused tendencies for Group I was 31.3%, and for Group II, 31.6%. Targeted area of clearly positive dynamics was only 50.0% for both Group I and Group II.

From Table 4 and Figure 3 the trends for both groups can be traced clearly:

- (1) The area of undesirable indicators for both groups is significantly larger for Environmental Safety Behavior than for Environmental Awareness – indeed, for Group I, it is double. This indicates that the behavioral aspects of the quality of implementing environmental education should be emphasized during the further organization of environmental education.
- (2) The area of undesirable indicators increases significantly for both groups of respondents when the results of Environmental Awareness and Environmental Safety Behavior are compared.
- (3) The targeted area of clearly positive dynamics for the same indicators decreases accordingly.
- (4) The respective graphs for Environmental Safety Behavior of Group I and Group II are almost superimposed, which indicates the similar success dynamics of the formation of these indicators in both groups of respondents.

- (5) For Environmental Awareness, the upper coordinates of the graphs of both groups are localized at the level of Rather Good, whereas, for Environmental Safety Behavior (an order of magnitude lower), the coordinates tend to a level between Low and Sufficient.
- (6) Environmental Awareness graphs for Group I and Group II are likely to differ, especially in relation to level of Environmental Awareness, which was 25.0% for Group I and only 18.4% for Group II – a difference of 6.6%.
- (7) Points 5 and 6 may indicate a difference in the effectiveness of teaching the theoretical foundations of environmental education, and the psychological formation of general ideas about the importance of environmental education for the different groups. However, by every measurement, neither the level of attitudes (which involves not only the level of understanding, but also the level of influence of this understanding on the corresponding correlation of behavior), nor the behavioral aspect (Environmental Safety Behavior) of the groups differ significantly – in both cases these aspects are equally undeveloped and in need of enhancement.

As mentioned, the stage of preliminary diagnostics is crucial for the implementation of the special environmental education activity involving the case study method, for the following two reasons. It will affect the results of secondary diagnostics, which is focused mainly on diagnosing the practical side of environmental education, and ensures harmonization with the problem areas identified.

Description and careful analysis of the process of special environmental education through active case study method implementation, which was introduced in the tested groups of respondents, can become material for the organization of a separate theoretical and generalizing study. The main points and highlights of this stage were described in Section 3. In the framework of current empirical research, we were rather concerned with the results of the secondary diagnostics, which indicate, directly, the effectiveness of the elaborated and implemented program.

4.2. Secondary Diagnostics

The results of the secondary diagnosis are summarized and presented in Table 5 and Table 6.

Table 5: Results of the secondary diagnostics in Group I and Group II after case-study-centred environmental education (diversified by stages / type of control assignments)

Level of Success	Group I		Group II	
	N	%	N	%
<i>Group Environmental Project Implementation*</i>				
Extremely Low	-	0.0%	-	0.0%
Low	-	0.0%	-	0.0%
Sufficient	2 subgroups	33.3%	1 subgroup	14.3%
Rather Good	2 subgroups	33.3%	3 subgroups	42.8%
High	1 subgroup	16.7%	2 subgroups	28.6%

Advanced	1 subgroup	16.7%	1 subgroup	14.3%
<i>Specialty-oriented Assignment</i>				
	Individual Research Region-targeted Project		Region-targeted Advanced Environmental Education Methodological Project (for primary school pupils)	
Extremely Low	-	0.0%	-	0.0%
Low	2	6.2%	3	7.9%
Sufficient	11	34.4%	10	26.3%
Rather Good	9	28.1%	13	34.2%
High	6	18.8%	8	21.1%
Advanced	4	12.5%	4	10.5%

Note: At this stage, there is no data on the number of respondents localized at a certain level. The general assessment for each subgroup was available and the percentages were calculated accordingly.

Table 6: Results of the secondary diagnostics in Group I and Group II after case-study-centred environmental education (generalized and averaged)

Level of Success	Group I	Group II
Extremely Low	0.0%	0.0%
Low	3.1%	4.0%
Sufficient	33.8%	20.3%
Rather Good	30.7%	38.5%
High	17.8%	24.8%
Advanced	14.6%	12.4%

According to the results of secondary diagnostics, the findings according to zoning were distributed as follows: in Group I, the area of undesirable indicators was 3.1%, and in Group II, 4.0% (no results were yielded at the level of Extremely Low for either group). Neutral area with confused tendencies in Group I was 33.8%, and in Group II, 20.3%. Targeted area of clearly positive dynamics in Group I was 63.1%, and in Group II, 75.7%.

To trace the trends clearly, it is expedient to compare the findings with the results of the preliminary diagnosis stage, namely the second stage of the experimental study, which assessed the activity-behavioral aspect of students' eco-style (Environmental Safety Behavior). The results are presented graphically in Figure 4. It shows distinctly that the situation changed after the implementation of case-study-centred environmental education. Activity-behavioral attitudes (professionally targeted, and general) strengthened significantly. Group II dynamics is particularly positive: the targeted area of clearly positive dynamics increased immediately, by 25.7%. For the same group, the range of the neutral area with confused tendencies narrowed significantly, to be exact, by 10.1%. Equally significantly, the range of the undesirable indicators area declined in both groups: at least 4.6 times. Overall, at the final stage of diagnosis, Group II had better results than Group I (Figure 4).

The consolidated data provides evidence of the success of the case-study-centred environmental education methodology that had been developed by the authors.

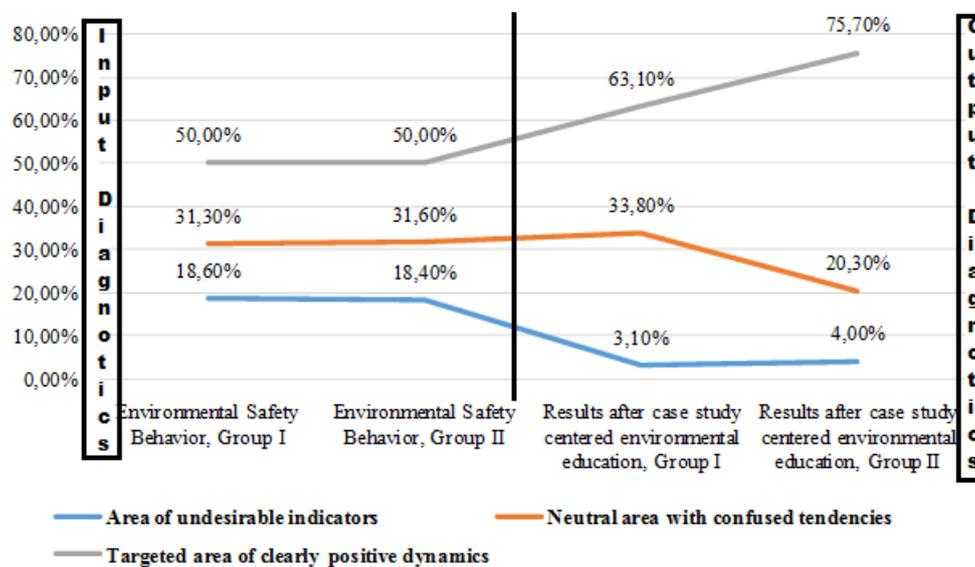


Figure 4: Final results

5. Discussion

The results of the study reveal a predicted dissonance between the theoretical and practical levels of consciousness regarding understanding and implementing the principles of eco-conservation and environmentally friendly behavior. At the theoretical level, students of both groups showed high-level cognizance of the basic principles of environmental education. However, their awareness of the theory was not supported by activity-behavioral manifestations, because theoretical knowledge was not transformed into personal and professionally oriented attitudes, which determine the practical side of an individual's life, and harmonizes it with the level of theoretical consciousness (Lerner & Richey, 2005; Mirghafoori et al., 2017). Experience promotes learning and learning results in changes in behavior (Ramirez, 2017).

We developed a scheme for the implementation of a training and experimental project that involved the application of the case study method, as well as an evaluation system that took into account (a) group and individual success aspects in the learning process, and (b) competence skills. Case-method-centred training integrated theoretical and practical knowledge and skills required by standard educational and professional programs. In contrast, the synergistic and mutually enriching development of the students' creative potential, research, and organizational and managerial activities was also emphasized.

On the one hand, this corresponds with the focus of innovative pedagogical models for teaching and learning for developing higher-order thinking skills and, on the other hand, realizes the need to adjust classical schemes for assessing students' academic success, to incorporate innovative tactics. Therefore, overall, the method of active implementation of the case study method also entails the problem field of educational effectiveness research, which concentrates on the factors that impact education outcomes (Sasson et al., 2018; Tanik Önal, 2020). However, there is still the problem of correlation with, reflection on and

influence of students' success in performing experimental forms of organized educational activities (enhanced implementation of creative pedagogy (Sasson et al., 2018) for assessing overall results of students' academic success). After all, despite the successful completion of all tasks by students, active involvement in the system of experiments, even by students with the least success, the current system of evaluation of respondents at the university is still severely limited by curricula and by the need to settle academic debts by passing traditional exams and tests that are regulated by educational and vocational training programs. In fact, overcoming such dissonance can provide insight for further research. The problem we detected is articulated by the current study, and suggests an approach that could be considered by future research. The problem needs profound theoretical and practical work. Moreover, we believe that there is a strong need to develop a system of coordination between curricular and extracurricular activities (e.g., students' research work), so that the various activities make at least equal contributions to the results informing students' academic success. Doing so would require serious institutional directive work, with the aim of fixing the problem. This topic could probably be even be an urgent pedagogical assignment for the whole national and international tertiary education community.

The finding of the secondary diagnosis that the results of Group II proved to be better than that of Group I, can be explained by a range of dependent and independent factors, the assessment of which requires thorough research. However, Group I respondents reported experiencing greater difficulty with the Individual Research Region-targeted Project. In such a way, the major problem the participants of Group I had was the problem of implementing the Individual Research Region-targeted Project. We assume that students with environmental specialties need to pay more attention to scientific work, especially during tasks that relate to solving environmental problems in their regions. We suppose, also, that the additional work of university teachers in this area (teaching students the methods of conducting practically targeted applied research work) would result in a higher success rate in this group of students. The respondents of Group II organized high-quality cooperation with the school and directly with the school's pupils, and enlisted the support of parents as well. They even succeeded when additional financial resources were needed to implement methodological projects for instilling eco-friendly behavior, and to promote eco-friendly attitudes in primary school pupils.

In general, the issue of funding the environmental projects that were initiated as part of the experiment is important. When they had to effect improvements to parks and water areas, the respondents faced problems relating to financial assistance to realize their plans (Ramirez, 2017). For example, they had to buy flower seeds, work equipment and plant stock. Future research should consider how to finance the students' environmental projects from either university funds, special eco-funds, or city and settlement council budgets.

The organization of group work at Stage 3 yielded particular practical value. It is advisable to create special student organizations that have strong potential to be

effective partners in environmental advocacy and promoting protection (Abdullah et al., 2018; Ramirez, 2017). To enhance the effective participation of students in environmental education and protection, higher education institutions could initiate the creation of extra student development funds to address the fiscal constraints faced by environment-related student organizations. In specialized student organizations, as demonstrated by the logic of the implementation of Stage 3, it is expedient to maintain a hierarchical organization headed by an authoritative leader. Any initiatives and activities organized to support the trends of eco-conservation and eco-friendly human behavior in the environment should be encouraged at an administrative level of the university, through financial acknowledgement, by taking into account the successes of eco-targeted behavior in the formation of reporting on the academic performance of socially active students (Ramirez, 2017).

An essential consideration should relate to the intricacies of implementing environmental education based on the principle of focusing on case study perspectives (Lerner & Richey, 2005). This method provides invaluable insights into the formation of practical skills and provides a deeper understanding of the nature of environmental problems. It also helps to prepare students for the direct implementation of professional activities after university graduation (Andersen & Schiano, 2014; Aznar-Díaz et al., 2019). However, using specific situations does not provide fair assessment of students' learning activities. Furthermore, fear of failure and receiving a negative score damages the usefulness of case studies (Lerner & Richey, 2005). During the introduction of case studies, the teacher performs the role of facilitator, and is a catalyst for constructive decisions, a coordinator, and a referee. These roles require preliminary training for all participants in the environmental learning process. The key factor in solving cases should not be only the desire to give the right answer – other important elements are the ideological brainstorm, the competitive impulse, leaders' behavior, and training students on soft and hard skills.

The very essence of environmental problems is that they cannot be grasped fully on a synchronous scale only: understanding the essence of an environmental problem requires a diachronic causal study, as well as individual ability to see prospects. Environmental problems are not always spontaneous, but arise from a systematic disregard of environmental protection principles. Consequently, the logic of case processing should always involve a comprehensive synchronous-diachronic context, in fact, solving these problems calls for special theoretical training as a minimum requirement.

The positive dynamics revealed by the outcomes of the research study is a consequence of syncretism and methodological symbiosis of two related modern methods: the case study method, and project-based learning (Rashid et al., 2019, Sasson et al., 2018).

6. Limitations

The findings of the study are partly limited by the small sample size. Yet, in the paradigm of the elaborated research model, it was not expedient to involve a larger number of respondents, due to a physical inability to engage qualitatively and entirely in all the stages, and to implement the principles of interactive subject-subject learning. The once-off nature of this study precludes us from expressly claiming that we identified certain trends regarding the logic and consequences of implementing a study case approach in environmental education. However, the findings clearly provide valuable evidence that can be used to verify the conclusions made in the process of organizing further research on the proposed model.

7. Conclusion

The application of the case study method not only made it possible to stimulate students' learning activities and increase basic professional competencies, but also minimized the gap between their theoretical understanding of environmental issues and the implementation of the principles of environmentally friendly and ecofriendly behavior in the lives of both groups of students. The students' proactiveness, their participation in the public life of the city, and their organizational skills also increased significantly due to their participation in the study.

The results yielded during the secondary diagnostics – the outcome according to the distribution of students by zones of success – shows a significant increase in indicators of the activity-behavioral aspects of professionally oriented environmental education. Thus, in Group I, the area of undesirable indicators is equivalent to 3.1%, and in Group II, 4.0% (no students of either group performed at the level of Extremely Low). The zone of neutral with confused tendencies was occupied by 33.8% of Group I, and 20.3 of Group II. The targeted area of clearly positive dynamics comprised 63.1% of Group I, and 75.7% of Group II. Overall, compared to the results of the input diagnostics, the zone of negative indicators decreased almost fivefold, and the zone of positive dynamics increased by 25% in the case of Group II.

Further research on the topic could relate to enhancing the use of the case study method in the context of environmental education. This area of enquiry will serve to minimize the gap between the theoretical and activity-practical levels of students' attitudes to their professional and general training, in accordance with environmental trends that are currently in the limelight in scientific and journalistic discourse.

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