

KONSTANTIN
PRESLAVSKY
UNIVERSITY
S H U M E N



*ШУМЕНСКИ УНИВЕРСИТЕТ
“ЕПИСКОП КОНСТАНТИН ПРЕСЛАВСКИ”*

FACULTY OF EDUCATION
DEPARTMENT OF ART EDUCATION AND TECHNOLOGICAL EDUCATION

IRINA BORISLAVOVA SLAVOVA

ABSTRACT

THEME:

Model for the Ecologization of the Technologies and Entrepreneurship Curriculum

of a dissertation thesis for the acquisition of the educational and scientific degree “doctor”
in the doctoral program: "Methodology of Teaching in Technics and Technologies"
from the professional field: 1.3. Pedagogy of Teaching..., field of higher education: 1.
Pedagogical Sciences

Shumen,

2026

INTRODUCTION

The escalation of environmental threats underscores the urgent need for the ecologization of educational content across all academic spheres. Modern education must establish the theoretical framework and prerequisites for fostering a balanced interaction within the "man-society-nature" triad.

„The understanding of ecological issues as scientifically grounded and pedagogically examined global challenges of contemporary society requires that they occupy a significant place within the internationally oriented educational system. This concept emerges from the globalization of society. The necessity of integrating environmental content into curricula is dictated by the existence of a unified economic, political, and cultural global space, which simultaneously functions as a unified natural system defined by countless interconnections" [41].

Contemporary society recognizes the need for a paradigm shift in the relationship between humanity and nature, acknowledging that such changes must commence with a transformation of global lifestyles. The educational, political, and economic systems, along with mass media, legislation, and public opinion, exert substantial influence on environmental conditions and serve as guarantors of the planet's ecological safety. Global environmental challenges necessitate continuous ecological education spanning from early childhood and primary schooling through secondary and higher education, extending into lifelong learning. Within the framework of modern environmental training, an ecocentric paradigm is emerging, which reinforces a holistic and ethically oriented approach toward recognizing the inherent sanctity, uniqueness, and intrinsic value of nature. In a global context, environmental education today is regarded as a fundamental, key component of broader social development aimed at improving the conservation and utilization of nature, thereby ensuring more stable development for individual nations and society as a whole amidst the global ecological crisis. In this regard, the contemporary vision for the formation of the human personality and its multifaceted relationships with the environment is vital—not only for the progress of new interactions with the social and natural surroundings but also for understanding the place of each individual within the large-scale scientific picture of the world.

Section II of Ordinance No. 5 of November 30, 2015, issued by the Ministry of Education and Science regarding general education [50], states that: "General education is acquired throughout the entire course of school schooling and encompasses the following key competencies:

1. Competencies in the field of the Bulgarian language;
2. Skills for communication in foreign languages;
3. Mathematical competence and basic competencies in the field of natural sciences and technologies..."
4. Digital competence;
5. Learning-to-learn skills;
6. Social and civic competencies;

7. Initiative and entrepreneurship;
8. Cultural awareness and expression through creativity;
9. Skills for supporting sustainable development, a healthy lifestyle, and sports.

General education is implemented through the study of various subjects, one of which is the subject of Technologies and Entrepreneurship.

Annex No. 19 to Art. 6, Para. 1, Item 19 specifies the learning outcome requirements for this subject. One of the specific educational goals at the primary stage is "the development of a positive attitude towards labor, the preservation of natural resources, and environmentally responsible behavior."

An analysis of the knowledge, skills, and attitudes resulting from education in the "Technologies" competency area indicates that the student must be able to "illustrate with examples the positive and negative impacts of engineering and technologies on human life."

At the lower secondary stage, four educational goals are defined, the third of which requires the student "to form an attitude towards a healthy and safe lifestyle and work environment, and towards adherence to the principles of sustainable development of society." In the "Agro- and Zootechnologies" competency area, the student must understand "ecological standards in plant cultivation and animal husbandry, and furthermore, be familiar with the requirements for healthy nutrition."

In the first stage of secondary education, within the "Technological Development and Entrepreneurship" competency area, the knowledge, skills, and attitudes resulting from training should enable the student to "evaluate goods and services based on criteria of innovation, quality, energy efficiency, and environmental safety."

In view of the above, we examine Ordinance No. 13 of the Ministry of Education and Science (MES) dated September 21, 2016, regarding Civic, Health, Environmental, and Intercultural Education [52].

Art. 3, Para. 4 of this ordinance states that "environmental education is aimed at the formation of ecological culture, ecological consciousness, and ecological behavior in their mutual relationship, with a view to understanding ecological laws, and the protection, improvement, management, and rational use of natural resources, as well as the preservation of the natural environment and ecological balance." Art. 4 outlines the goals of this education, namely:

- i) selecting adequate information, products, and services to improve health and maintain a healthy lifestyle for oneself and others;
- j) knowing and adhering to the norms of ecological culture and behavior with a view to preserving nature and creating a sustainable environment;

k) understanding the mechanisms of public institutions and civil society for implementing shared responsibility for environmental protection and demonstrating readiness for participation in them.

The possibilities for integrating environmental education, in accordance with Art. 8, Para. 2, are related to the enhancement of specific key competencies through the study of general education subjects within elective school hours. In this regard, it proves feasible to ecologize the curriculum content of the subject Technologies and Entrepreneurship across all stages of school education.

Art. 10, Para. 1 states that: "Civic, health, environmental, and intercultural education, within the process of acquiring supplementary training, may be implemented through instruction in academic subjects or modules, via interdisciplinary programs, projects, or activities at the teacher's discretion.

Art. 10, Para. 2 further specifies that: "Civic, health, environmental, and intercultural education during the 'class teacher's hour' is also realized through activities for the consistent development of the class as a community and through student self-governance at the class and school levels.

According to Art. 13, Para. 2 and Para. 3, within the Centers for Support for Personal Development, civic, health, environmental, and intercultural education are carried out within the framework of the activities under Art. 49, Para. 1 of the Pre-school and School Education Act and in a manner determined by their respective internal regulations. (2) For the designated activities in civic, health, environmental, and intercultural education, pedagogical specialists shall develop a program to be approved by the director of the Center for Support for Personal Development.

The framework requirements for learning outcomes in civic, health, environmental, and intercultural education are detailed in Annex 3 of this Ordinance. According to the framework requirements in this annex, an analysis of the learning outcomes in environmental education reveals that they are directly linked to the learning outcome requirements for Technologies and Entrepreneurship. This confirms the relevance and significance of the problem regarding the ecologization of the curriculum content in the subject Technologies and Entrepreneurship, within the context of the global ecological crisis. This crisis is an established fact, and its challenges can only be resolved through the combined efforts of all generations, particularly the younger generation, which must possess a high ecological culture and the eight key competencies specified in Ordinance No. 5 of the Ministry of Education and Science, dated November 30, 2015.

In the context of Ordinance No. 5 of November 30, 2015 [50] regarding general education, the subject of Technologies and Entrepreneurship is aimed at acquiring skills to respond to innovations and to take responsibility, while building initiative and entrepreneurship. The specific educational goals for Technologies and Entrepreneurship (Annex No. 19) are as follows:

- Mastering fundamental knowledge, skills, and attitudes related to engineering and technologies.
- Cultivating a positive attitude towards engineering and technologies and understanding their role in life.
- Developing basic knowledge, skills, and attitudes related to contemporary economic life.
- Understanding the significance of various professions and the necessity for leadership in community development.
- Fostering initiative, entrepreneurship, and responsibility.
- Building a positive attitude towards labor, the conservation of natural resources, and an environmentally friendly lifestyle.

Examining Competency Area 9 in the same annex, "Skills for Supporting Sustainable Development and for a Healthy Lifestyle and Sports" [50], it can be concluded that this area requires knowledge, skills, and attitudes related to the student's ecological culture. The latter is naturally a result of environmental education and the ecological upbringing of the student within the context of the ecologization of the curriculum content in Technologies and Entrepreneurship. With this in mind, the hypothesis, along with the related object, subject, and tasks of this doctoral dissertation, are formulated as follows:

Hypothesis: The ecologization of the curriculum content in the subject Technologies and Entrepreneurship is a guarantee for the formation of the necessary ecological culture among students in the conditions of a global ecological crisis.

Object of Research: The curriculum content of the subject Technologies and Entrepreneurship.

Subject of Research: Technologies and Entrepreneurship and the ecologization of the curriculum content—ecological concepts related to the instruction.

Aim: To develop a model for the ecologization of the curriculum content in the subject Technologies and Entrepreneurship.

Tasks:

1. To conduct a historical review of the concept of entrepreneurship.
2. To analyze the regulatory documents related to the instruction in the subject Technologies and Entrepreneurship.
3. To examine the ecological concepts within the textbooks of this subject.
4. To propose a model for the ecologization of the curriculum content in the subject Technologies and Entrepreneurship.

Chapter One: Ecologization of Curriculum Content presents the current challenges regarding the integration of environmental principles into educational materials.

Within the educational policy of the European Union over the past decade, ecological values, knowledge, and behavioral models have occupied a vital position in the general framework of educational and upbringing processes, becoming an indispensable part of the curricula across all types and levels of schooling. The ecological dimension is evolving into one of the primary aspects of modern education.

Currently, the issue regarding the status and trends of the ecologization of education under contemporary conditions is of particular relevance, serving as a key indicator of the social significance and innovative potential of educational institutions. The integration of ecological criteria into all structures of human activity as an innovative approach to resolving environmental issues makes the development of an adequate ecological culture an urgent necessity [26, 28, 29, 39, 40].

The mastery of ecological and ethical norms, attitudes, and values is highly recommended due to the shifts in how individuals communicate with their environment. This is driven by the emergence and establishment of ecological responsibility and the creation of active stereotypes for interacting with nature, which in some cases persist throughout a lifetime. These processes pose critical questions for teachers regarding the essence of effective environmental education and upbringing—namely its goals, forms, structure, and means. In this direction, pedagogy increasingly seeks alternative pedagogical technologies. Organizing, planning, and conducting modern instruction within an interactive educational environment is a necessary option that guarantees the effectiveness of the educational process without negating the advantages of the traditional pedagogical approach, where educators assume full responsibility for the learning process. For the purpose of sustainable progress, it is necessary to provide every student with the opportunity and freedom to take responsibility for their part, to be active, to communicate with adults, and to seek and propose solutions. Thus, the student assumes an equal place in the organization and implementation of the cognitive process, acting as its primary protagonist [39].

The formation of an ecological culture can be achieved only through the presence of a solid environmental protection background in the teacher. This factor is a prerequisite for successful results. Only an educator who is deeply convinced of the importance of the environmental problem can instill in children a lasting need for environmental conservation. Human behavior toward nature is directly dependent on consciousness, and ecological consciousness is shaped from early childhood throughout an individual's entire life. The human–society–nature relationship encompasses biological, political, economic, health, and pedagogical dimensions of research.

The imperative for the protection, rational use, preservation, and reproduction of nature poses an urgent and essential challenge for pedagogy: environmental upbringing.

In the interaction between humans and nature, the primary role belongs to humanity. It is the individual who determines which methods will be used to protect the environment. For this reason, in the process of cultivating an affinity for nature, the student must be both the object and the subject of pedagogical influence.

This chapter outlines the place and significance of environmental education in pedagogical theory and practice, as well as the necessity for comprehensive ecological knowledge to form an ecological culture. Special emphasis is placed on the ecological responsibility of educators. It is noted that the issue of nature protection and the rational use of its resources is increasingly emerging as one of the most critical and even fateful challenges of our time. This problem will be addressed by various specialists, many of whom are students today. They must not only know that a crisis is imminent but must be internally convinced that human culture should develop only in harmony with natural and ecological laws. To fully realize this requirement, special attention must be given to environmental education and upbringing. These are the primary means for fostering a caring and responsible attitude toward nature and an intolerance for any actions that harm the environment.

In environmental education, alongside general pedagogical principles, a system of specific principles is applied for the selection of curriculum content and the organization of teaching activities. These specific principles can be defined in two groups:

Principles related to the object of study: the unity and diversity of the natural environment, the complex significance of nature for society, the global nature of environmental problems, and the socio-structural determinants of attitudes toward the environment.

Principles related to the instructional processes: detailed knowledge of the environment, the unity of theory and practice in studying and solving environmental problems, the consistency and continuity of environmental education, the integration of the intellectual, emotional, and volitional spheres of the individual in mastering environmental content, the synergy between local, national, and global aspects of the curriculum, and the harmonious influence of all environmental factors on the child's personality.

- The curriculum content of environmental education includes:
 - A system of knowledge regarding ecological objects and processes;
 - Methods for their study;
 - Paths and means for the interaction between society and nature, and the character of natural resource management;
 - The consequences of social impact on the ecological balance and methods for its optimization;
 - A system of skills, habits, practical rules, and means for studying nature and applying ecological knowledge in direct production practice;
 - Experience in creative activities focused on nature study and environmental problem-solving;
 - A system of ecological norms, rules, and values, and their role in social practice and personality formation.

The development of ecological consciousness, a new way of thinking, and a new value system requires that mastered ecological norms be transformed into behavioral standards toward

nature. Environmental education depends on the integration of knowledge from various academic fields and on bridging the gap between social and educational experience.

Chapter Two: Entrepreneurship – Essence and Significance examines the nature and various types of entrepreneurship. Entrepreneurship is identified as a key competence for the modern individual. In this regard, it is no coincidence that the European Union defines "sense of initiative and entrepreneurship" as one of the eight key competencies for lifelong learning, the mastery of which must be ensured for young people by the educational systems of all Member States.

Entrepreneurial competence is a complex set of attitudes and life skills—problem-solving, taking personal and social responsibility, curiosity and perseverance, communication and interaction with others, creative skills, and more. It manifests as the ability to recognize and seize opportunities, as well as in the creative planning and management of processes with cultural, social, or financial value. This is a multifaceted competence that presupposes knowledge of the context and available opportunities, ethical principles, and self-awareness. Furthermore, it includes creative skills (imagination, critical reflection, problem-solving), resource mobilization, communication, and the capacity to cope with uncertainty, ambiguity, and risk, as well as attitudes toward self-assessment, motivation, persistence, and the evaluation of others' ideas. Similarly, innovation competence consists of a combination of specific personal characteristics, social skills, content knowledge, forward-looking thinking, creative thinking, and project development and management skills. Entrepreneurship education aims to develop students' skills and mindset so they can transform creative ideas into entrepreneurial actions.

At the primary stage (ages 8–10), students will acquire skills such as initiative and entrepreneurship, defined as the ability to transform ideas into actions that provide value not only to oneself but also to others. Teachers will not be teaching more, but differently. The curriculum will not be burdened with additional content; instead, more effective teaching and learning methods will be employed. Furthermore, teacher training courses, a teacher's toolkit (comprising lesson plans and didactic materials), a methodological implementation manual for school principals, a strategy for the mass adoption of the methodology, and educational reform initiatives will be established.

The "Cradle" methodology being applied is a synthesis of existing methodologies and integrates three core educational approaches: Learning-by-doing and cross-curricular links; Content and Language Integrated Learning (CLIL); and Entrepreneurship Education. It is inspired by Design Thinking and seeks to replicate the designer's way of working and thinking. This is a skills-based instructional approach centered on project work, with a specific emphasis on self-management, research, experimentation, visualization, and action. Teachers utilizing the "Cradle" methodology combine these three elements into lesson cycles based on themes from the general education curriculum.

Activities must support and sustain the fundamental skills and knowledge of primary school students. Consequently, students will acquire core competencies while simultaneously developing

essential language and entrepreneurial skills—gaining experience in problem-solving, developing new solutions, and executing them through concrete actions. Ideally, student ideas and actions should possess entrepreneurial characteristics, meaning they should hold universal value and provide real benefit to others.

The European Reference Framework for Key Competences defines entrepreneurship as a transversal skill applicable to all spheres of life: personal development, active citizenship, social inclusion, re-entering the labor market as an employee or self-employed person, and launching enterprises (of cultural, social, or financial value).

As a result, entrepreneurship:

- Requires an understanding of situations and opportunities, methods for planning and management, ethical principles, and self-awareness;
- Includes creative skills (imagination, critical analysis, problem-solving), resource mobilization (human and material), communication, and the ability to cope with uncertainty, ambiguity, and risk;

Involves attitudes of self-efficacy, motivation, perseverance, and the valuing of others' ideas.

The conception that entrepreneurship education effectively enhances students' knowledge and skills, along with the potential of schools to create a stimulating and supportive learning environment, is as vital as the personal skills and motivation of the educators. Entrepreneurship education is not possible in a school setting isolated from the outside world. This type of instruction requires teamwork with external organizations to provide diverse learning experiences.

The significance of entrepreneurship education in the Republic of Bulgaria was recognized as early as the beginning of the last century, when various entrepreneurial practices found their place in student curricula. Intense European messages regarding entrepreneurship education were integrated into Ordinance No. 5 of November 30, 2015, issued by the Minister of Education and Science regarding general education. Article 2 of the ordinance states that: "General education is acquired throughout the entire course of school schooling and encompasses the following groups of key competencies: competencies in the field of the Bulgarian language; skills for communication in foreign languages; mathematical competence and basic competencies in the field of natural sciences and technologies; digital competence; learning-to-learn skills; social and civic competencies; initiative and entrepreneurship; cultural awareness and expression through creativity; and skills for supporting sustainable development, a healthy lifestyle, and sports." This ordinance introduced 20 general education subjects for the basic level of education, including the subject "Technologies and Entrepreneurship." It is aimed at acquiring skills to respond to innovations and to take responsibility, while building the capacity for initiative and entrepreneurship.

• Instruction in "Technologies and Entrepreneurship" commences in the first grade and continues through the end of the lower secondary stage, with one class hour per week. The specific educational objectives set by the state to be achieved during these two stages are as follows:

- At the Primary Stage of Education (Grades 1-4):

- Mastery of fundamental knowledge, skills, and attitudes related to engineering and technologies.

- Cultivation of a positive attitude towards engineering and technologies and an understanding of their role in daily life.

- Development of basic knowledge, skills, and attitudes related to contemporary economic life.

- Understanding the significance of various professions and the necessity for leadership in community development.

- Fostering initiative, entrepreneurship, and responsibility.

- Building a positive attitude towards labor, the conservation of natural resources, and an environmentally friendly lifestyle.

- At the Lower Secondary Stage of Education (Grades 5-7):

- Building students' basic technological competence related to:

- the use of equipment for manual and machine processing of materials;

- independent project development through the application of accessible software products;

- communication and quality control.

- Initiating the formation of the key competence "Initiative and Entrepreneurship" through:

- exposure to a real economic environment;

- researching best entrepreneurial practices;

- demonstrating entrepreneurial initiative.

- Forming an attitude towards a healthy and safe lifestyle and work environment, as well as adherence to ecological requirements and the principles of sustainable development.

- Creating conditions for making an informed choice regarding future education and profession.

- Within the Framework Curricula of the First and Second Stages of Secondary Education (Upper Secondary), entrepreneurship education is represented to varying degrees—typically in the 8th grade, while in the 10th grade, it is predominantly delivered through the subject of "Economics." The objectives of this instruction are:

- Understanding the role of technologies in solving problems within entrepreneurial activities;

- Activating the initiative and entrepreneurship of learners;

- Motivating students to make an informed choice regarding their career paths;

- Recognizing opportunities for career development and selecting appropriate specialized training;

- Expanding knowledge that ensures economic and financial literacy and developing entrepreneurial skills for starting a business within a free-market environment.

The established state standards for promoting entrepreneurship education are aligned with contemporary trends in the national and global economy, although they were implemented as recently as the 2016/2017 academic year.

In Chapter Three, "Curriculum Content in Technologies and Entrepreneurship and Opportunities for Ecologization," special attention is given to entrepreneurship as an integral part of the subject Technologies and Entrepreneurship, and specific recommendations are made for the respective curricula. To ensure that entrepreneurship education is effective and achieves the results desired by society, the following transformations are implemented within the school-level curricula:

Transformation of the teacher's role in the classroom—from an instructor to a facilitator who enables children to discover the answers to their own questions;

Granting greater autonomy to teachers in deciding which educational resources to utilize in the classroom;

Integrating business professionals into the learning process, thereby establishing a real connection between education and business through mentorship, active experience sharing, and participation in various educational formats that allow students to engage freely with professionals;

Active involvement of parents in the educational process, which can include their participation as experts from the business or public sectors;

Practically oriented instruction, where ideas are tested in practice through projects and direct action;

Strong emphasis on teamwork, aimed at creating essential work habits that are vital for future professional development. defining and implementing cross-curricular links, whereby entrepreneurship education supports the achievement of better learning outcomes in other subjects, while increasing students' motivation to learn;

Utilizing more interactive and non-traditional teaching approaches, breaking the isolation of schools, encouraging active collaboration between different educational institutions, and organizing competitions and other formats that provide young people with opportunities for self-expression and social networking;

Ensuring a two-way connection with the business sector: not only bringing business into the school but also taking the school to the business through educational visits, as well as short-term or long-term internships.

The role of Technologies and Entrepreneurship teachers in today's schools is of paramount importance. To achieve the ambitious goals set for this subject, several essential conditions must be met:

- Initial teacher training must be of high quality.
- Students in pedagogical specialties must have the opportunity to gain experience in entrepreneurship education in all its aspects, mastering a set of skills and methods that grant them the freedom to be innovative and entrepreneurial.
- Novice teachers who are familiar with entrepreneurial principles can, from the very start of their professional career, stimulate the entrepreneurial spark in their students and inspire them.

- Teacher training institutions can benefit from defining a mission and a clear vision of how entrepreneurial strategies can facilitate the achievement of their institutional goals.

- Entrepreneurship education can be implemented as a horizontal approach across the entire curriculum if it is treated as a key transversal skill essential for all teaching qualifications, rather than an isolated subject.

- Teacher preparation programs for entrepreneurship should be based on new pedagogical techniques and innovative teaching methods.

- The development of entrepreneurial skills requires active learning strategies.

- It is imperative to employ modern pedagogical techniques (such as active or self-directed learning, and project-based learning), which should be piloted within specialized programs.

- Teacher training specialists must be required to exchange best practices, which can subsequently be integrated into their future pedagogical work.

- All students should be provided with non-traditional learning environments, including real-life situational contexts outside the classroom.

- High-quality Continuing Professional Development (CPD) programs are essential for active teachers, enabling those who did not receive entrepreneurship training during their initial education to compensate and stay current with the latest trends.

- Access to qualitative opportunities for ongoing professional growth.

- Working within a school culture that values the entrepreneurial spirit and receives functional support from school leadership.

- An entrepreneurial school possesses a clear vision for its future and an understanding of how entrepreneurship education integrates into its broader curriculum and development plan.

- The initial development of entrepreneurship during teacher training is unlikely to achieve the desired results if teachers subsequently work in schools that lack a concept for entrepreneurship education.

- School management is a critical component for entrepreneurship teachers, as substantial administrative and organizational support is required.

- Schools and teacher training institutions must establish links and structures for collaboration with local businesses and community organizations to support the implementation of the entrepreneurship curriculum.

- To ensure sustained quality, teachers involved in entrepreneurship education should establish a routine for regular meetings to exchange experience, knowledge, and instructional materials.

The mission of the Technologies and Entrepreneurship education is directly linked to the role of general education in acquiring core technological competencies. It aims at achieving scientific literacy, mastering skills to respond to innovations, taking responsibility, and fostering a sense of initiative and entrepreneurship. The general objectives of this instruction are directed toward forming competencies that will enable students to build frameworks for action within:

- ✓ rapidly evolving scientific knowledge and innovations;

- ✓ fast-changing technologies and their impact on human development;
- ✓ the successful fulfillment of various social roles, allowing them to become productive and responsible citizens.

The characteristic features of technological education are found in:

The unique learning environment, where students master cognitive skills for:

- independent searching and interpretation of relevant information;
- generating and materializing (designing, technological planning, and modeling) ideas for products that are tested in practice;
- The integrative nature of technological knowledge regarding both content and activities;
- The simultaneous occurrence of educational and practical activities, with an emphasis on:
 - technological processes;
 - stages for mastering technical and technological literacy;
- The application and transfer of skills for solving diverse technological problems;
- Mastering and applying procedures and techniques for the assessment and self-assessment of technological activity results;
- Mastering and applying models for cooperation and mutual assistance during teamwork;
- Orientation and preparation for professional choice and career development.

In the process of technological education, students engage in various interactions aimed at the active application of knowledge acquired from other subjects in different contexts, developing skills for the transfer of knowledge, skills, and competencies. In this regard, technological education acts as a catalyst for the processes of systemic integration and transfer of knowledge and skills mastered by students across separate academic subjects at the lower secondary stage (mathematics, physics and astronomy, geography and economics, history and civilization, information technology, biology and health education, Bulgarian and foreign languages, fine arts, etc.).

In these functions, technological education acts as a natural integrative center within the overall educational process. In this context, technological training provides an appropriate environment for integrating economic knowledge and entrepreneurial skills, as the interconnections between humanity, the environment, technology, and economy are inherently present in its content.

Within the educational process of Technologies and Entrepreneurship, technological literacy and entrepreneurial skills occupy a central place, directing students' thinking toward finding answers to: knowing what, knowing where, and knowing how. The fundamental pillars for mastering the curriculum content are the interactions: I have an idea, let's think together, let's act together.

The transition from childhood to maturity, which occurs between the ages of 11 and 14, is exceptionally dynamic and accompanied by numerous quantitative and qualitative changes in

student development. The qualitative shifts in cognitive processes within Technologies and Entrepreneurship education are directed toward:

The formation of conceptual structures for understanding and applying criteria in the classification of objects, phenomena, and processes related to technologies, which allows for the comprehension of the relationships: "object – environment"; "environment – function"; "function – construction"; "science – technology";

- Orientation in three-dimensional space through the development of skills for graphical representation of objects using axonometric and orthogonal projection methods;

- The enrichment and expansion of knowledge and technological experience for utilizing a wider range of materials, tools, and machines to solve practical tasks with the demonstration of initiative and entrepreneurship;

- The development of thinking from "visual-figurative" to "abstract logical," which enables the posing and resolution of real-life situations containing economic problems, leading to the comprehension of the relationships: "technologies – economics – entrepreneurship – economic culture".

The cognitive and practical experience accumulated by students during this age period allows the curriculum of Technologies and Entrepreneurship to set objectives and activity contexts that expand their potential across the six key competency areas, aimed at developing lifelong learning competencies.

In this context, three levels of relationships emerge within the content of Technologies and Entrepreneurship education:

Level I: Labor activity – Engineering – Monotechnologies – Technical literacy;

Level II: Science – Information and Communication Technologies – Engineering – Technological culture;

Level III: Technologies – Economics – Entrepreneurship – Economic culture.

The specific educational objectives of Technologies and Entrepreneurship at the lower secondary stage are formulated as follows:

Expanding students' basic technological competence related to:

- a) the use of equipment for manual and machine processing of materials;
- b) independent project development through the application of accessible software products and digital tools for communication and control.

Developing the key competence "Initiative and Entrepreneurship" through:

- a) exposure to a real economic environment;
- b) research of best entrepreneurial practices;
- c) demonstration of entrepreneurial initiative.

Forming an attitude towards a healthy and safe lifestyle and work environment, adherence to ecological standards, and the principles of sustainable development of society.

The European Reference Framework for Key Competences [34] serves as the foundation for defining the six areas of competence within the subject of Technologies and Entrepreneurship:

Designing, planning, and evaluation of technological processes and objects.

Domestic and industrial equipment.

Processing, assembly, and combination of materials, products, and modules.

Communication and control in household and labor processes.

Organization and economics.

Agro- and zoo-technologies.

For each of the six areas, the knowledge, skills, and attitudes that the student must master by the end of the lower secondary stage have been defined. The link between specific expected learning outcomes and the corresponding key competence is also established.

For example: In the competence area "Domestic and Industrial Equipment," the expected outcomes are linked to the following key competencies:

Skills for communication in foreign languages;

Mathematical competence and basic competencies in the field of natural sciences and technologies;

Digital competence;

Learning-to-learn skills;

Skills for supporting sustainable development and a healthy lifestyle.

Introduction to the world of engineering and technology begins as early as kindergarten and continues through primary school. Children utilize various technical devices without necessarily understanding their underlying operating principles, yet this does not hinder their use of different functions. This is where the subject of Technologies and Entrepreneurship plays a vital role in revealing the theoretical and practical foundations of modern engineering. Contemporary human labor in all fields is becoming increasingly intellectualized, which directly influences the requirements for the technical and technological preparation of students. In the primary school period, the keyword is literacy. This refers not only to acquiring reading and writing skills but also to mastering the fundamentals of technical and technological literacy. Refining the use of basic tools and implements—which, while not among the most advanced modern devices, remain relevant and essential in daily life (e.g., scissors, knives, needles, etc.)—is also a crucial part of this literacy and should not be underestimated.

Student motivation—encompassing interest, desire, goal-setting, and satisfaction—plays a vital role in effective learning. A qualitatively new aspect of contemporary technological education is the approach toward implementing integrative interactions between academic subjects based on the key competencies defined by the European Reference Framework. Through the exemplary activities and cross-curricular links presented in the curriculum, coherence and synergy between the contents of different subjects are achieved. Simultaneously, the new subject of Technologies and Entrepreneurship introduces students to the sphere of economic relations, including the understanding of basic economic concepts, taking responsibility, decision-making, and

participating in charitable activities. In this way, the foundations of economic literacy and the conceptual image of the entrepreneur are established.

At the primary stage, entrepreneurship education is associated with developing the student's confidence to seek opportunities, to utilize their creative potential for their realization, and to act without fear. This is essentially the so-called "learning through entrepreneurship," based on a broad understanding of entrepreneurship as a mindset. Its primary objective is to form the knowledge, skills, and attitudes that build enterprise and initiative as one of the key competencies for an individual's full personal and professional realization. The only way for a person to develop an entrepreneurial spirit is to learn from their own experience. Therefore, experiential learning (learning-by-doing) plays a leading role in this process and must create value. In cases where a pedagogical intervention enables students to create value for others (beyond their own group and teachers), it constitutes authentic entrepreneurial education.

Enterprise and initiative as a key competence are achieved through diverse practical activities that encourage students' creative and innovative thinking. Emphasis is placed on building teamwork and decision-making skills, while fostering respect for the individuality and qualities of others. For instance, at the beginning of the school year, the class establishes rules for group work tasks—ensuring everyone has the opportunity to express their opinion, practicing active listening, and making decisions collectively, such as through voting. Presenting the results of assigned tasks is also a vital element of these activities; it enables students to build confidence and the ability to demonstrate their ideas persuasively. Teamwork and collective decision-making are of paramount importance. Furthermore, skills for presenting and defending an idea are actively encouraged.

Through discussions and various activities, such as role-playing and mind maps, students master new concepts and develop related practical skills. In a game-based format, they are introduced to the process of structuring entrepreneurial activity using the so-called Business Model Canvas. This is a widely used tool for analyzing revenue streams and costs, customer segments, and the value proposition created for them. The Canvas is presented in a simplified version, using language accessible to the children's age group. The questions within the Canvas categories aim to provoke innovative solutions and analytical thinking in students.

Entrepreneurship topics also provide ample opportunities for teacher collaboration and teamwork. Tasks can easily be expanded and integrated into extracurricular activities or elective school hours.

This chapter provides an analysis of the instruction in the subject "Technologies and Entrepreneurship" for the first, second, third, fourth, fifth, sixth, and seventh grades.

Chapter Four: "Ecologization of the Curriculum Content in Technologies and Entrepreneurship" presents the specific objectives of the instruction in technologies and entrepreneurship.

The specific objectives of teaching Technologies and Entrepreneurship at the primary stage and basic stage are:

- Mastery of fundamental knowledge, skills, and attitudes concerning engineering and technologies.
- Formation of a favorable attitude towards engineering and technologies and recognition of their significance in human life.
- Development of key knowledge, skills, and attitudes regarding contemporary economic life.
- Identification of the key contributions of various professions and the necessity for leaders in community development.
- Formation of a favorable attitude towards labor, environmentally responsible behavior, and the conservation of natural resources.
- Cultivation of entrepreneurship, initiative, and responsibility.

Specific objectives of teaching the subject Technologies and Entrepreneurship at the lower secondary stage:

Within the basic level of education, and specifically at the lower secondary stage, the specific objectives of teaching Technologies and Entrepreneurship are:

- The formation of core technological competence among students, related to:
 - ✓ The use of techniques for manual and machine processing of materials;
 - ✓ Individual project development through the application of accessible software products and digital tools for communication and control.
- Initiating the development of the key competence "Initiative and Entrepreneurship" through:
 - ✓ Integration into a real economic environment;
 - ✓ Analysis of best entrepreneurial practices;
 - ✓ Demonstration of entrepreneurial initiative.
- Building an attitude toward a healthy and safe lifestyle and work environment, in accordance with ecological standards and the principles of sustainable development.
- Establishing the prerequisites for making an informed choice regarding future education and professional career paths.

The planned educational outcomes (knowledge, attitudes, and skills) are categorized within the context of specific core competencies in Technologies and Entrepreneurship as follows:

- Competencies in the field of the Bulgarian language
- Skills for communication in foreign languages
- Mathematical literacy and key competencies in the field of natural sciences and technologies
- Digital competence
- Learning-to-learn skills
- Social and civic competencies
- Initiative and entrepreneurship

- Cultural awareness and expression through creativity
- Skills for supporting sustainable development, a healthy lifestyle, and sports.
- Analysis of Competency Areas in the Basic Level of Education: Primary Stage

The analysis of the competency areas specified for the basic level of education, primary stage (Annex No. 9, Ordinance No. 5), regarding Competency Area 9: "Skills for Supporting Sustainable Development and for a Healthy Lifestyle and Sports" indicates the following:

In the competence area of Engineering and Safety, the skills for supporting sustainable development and a healthy lifestyle are situated within the context of acquired knowledge, skills, and attitudes in the following core:

- Understands the function of common household appliances and their safe and environmentally friendly use.

In the competence area of Technologies, the skills for supporting sustainable development and a healthy lifestyle are situated within the context of acquired knowledge, skills, and attitudes in the following cores:

- Knows the technologies for cold processing of food products during food preparation – cleaning, washing, and cutting.
- Lists rules for the cultivation of plants and the rearing of domestic animals.
- Illustrates with examples the positive and negative impact of engineering and technologies on human life.

In the competence area of Initiative and Entrepreneurship, the skills for supporting sustainable development and a healthy lifestyle are situated within the context of acquired knowledge, skills, and attitudes in the following cores:

- Demonstrates proactivity, ingenuity, and imagination while working on various topics and projects.
- Connects the production of goods and services with the satisfaction of personal and public interests.

In the sphere of Designing and Modeling, the competence for supporting sustainable development and a healthy lifestyle is situated within the context of acquired knowledge, skills, and attitudes in the following core:

- Evaluates their own work and the work of others based on specific criteria.

Analysis of Competency Areas in the Basic Level of Education: Lower Secondary Stage

The analysis of the competency areas specified for the basic level of education, lower secondary stage (Annex No. 9, Ordinance No. 5), regarding Competency Area 9: "Skills for Supporting Sustainable Development and for a Healthy Lifestyle and Sports" indicates the following:

In the competence area of Domestic and Industrial Equipment, the skills for supporting sustainability and preventive health culture are aligned with the knowledge, skills, and attitudes in the following cores:

- Familiar with methods for storing, transporting, and transforming energy.
- Operates machines and tools in accordance with the operating conditions.
- Complies with operational safety rules and the rational use of energy when working with the equipment used.
- Demonstrates competencies for maintaining the hygiene of the household and the working environment.

In the competence area of Processing, Assembly, and Combination of Materials, Products, and Modules, the skills for supporting sustainability and preventive health culture are aligned with the knowledge, skills, and attitudes in the core:

- Handles basic technological operations in the processing of materials and products.

In the competence area of Organization and Economics, the competencies for supporting sustainability and preventive health culture are aligned with the knowledge, skills, and attitudes in the core:

- Plans and executes a project according to specified criteria.

In the competence area of Agro- and Zootechnologies, the skills for supporting sustainability and preventive health culture are aligned with the knowledge, skills, and attitudes in the following cores:

- Uses various sources of information for choosing a profession and career.
- Recognizes different methods for managing fruits, vegetables, ornamental plants, and herbs.
- Presents technologies for rearing animals at home and on the farm.
- Understands the benefits of ecological standards in the breeding of plants and animals.
- Is familiar with the requirements for healthy nutrition.

A special place in this dissertation is occupied by the Model for the Ecologization of the Curriculum Content in Technologies and Entrepreneurship.

"In accordance with the Framework Requirements for Environmental Education, the opportunities for greening the curriculum in the subject Technologies and Entrepreneurship are fundamental to the acquisition of additional skills, knowledge, and attitudes during the primary stage of education. The objective is to enable students to characterize the structural elements of atmospheric air and the stages of the water cycle, with a specific emphasis on the ecological significance of the atmosphere and soil, as well as their vital role for living organisms and human

health. Furthermore, the curriculum provides a basis for students to justify the necessity of protecting natural components and to recognize the personal responsibility of the individual.

The student evaluates the systemic integrity of components such as air, water, plants, animals, and soil. They identify technological solutions for energy generation and interpret their impact on the ecological footprint and the environment. The student provides arguments for the contribution of energy efficiency and establishes ethical norms within the family, the school, and the classroom. They interpret the primary methods of nature conservation—such as protected areas and reserves—alongside the sustainable use of resources and the maintenance of cleanliness in natural and protected territories.

Furthermore, the student explains the concept of waste, provides descriptions, and categorizes diverse types of municipal waste according to their composition (organic, paper, plastic, glass, wood, metal, etc.). They investigate the impact of environmental pollution on human health. The student defines rules for sustainable behavior regarding waste management in the classroom, family, school, and public spaces, as well as in the mountains and coastal areas. Finally, they design action plans and participate in collective initiatives for environmental protection.

Additional environmental skills, knowledge, and attitudes within the framework of curriculum greening in the lower secondary stage of education include:

- **Pollution Analysis:** Identifying primary sources of soil, air, and water pollution; recognizing various pollutants and evaluating their specific effects on human health.
- **Mitigation and Modeling:** Defining practical measures to optimize environmental quality and designing models/projects aimed at preserving the purity of air, water, and soil.
- **Acoustic Ecology:** Correlating noise levels and sources with their impact on physiological and psychological human health.
- **Behavioral Modification:** Analyzing potential shifts in daily habits to minimize individual contributions to environmental pollution.
- **Energy Systems:** Systematizing energy sources and production methods (coal, gas, oil, wind, hydro, solar) based on their environmental impact and internalizing the concept of "Green Energy."
- **Climate Dynamics:** Analyzing the nexus between climate change and natural disasters; defining strategic actions for ozone layer preservation and ecosystem integrity while demonstrating personal commitment.
- **Biodiversity Stewardship:** Systematizing flora, fauna, and fungi alongside their habitats; analyzing risks leading to biodiversity degradation and species extinction.

- **Conservation Frameworks:** Evaluating the significance of protected areas and classifying them (reserves, national parks, nature parks, maintained reserves, protected localities, and natural landmarks).

- **Resource Management:** Structuring plans and projects for the rehabilitation and sustainable management of biological resources, formulating concrete measures for ecosystem preservation.

- **Waste and Material Science:** Categorizing waste by origin (municipal, industrial, construction, agricultural, hazardous); justifying the necessity of material reuse and structuring recycling concepts.

- **Chemical Safety:** Presenting safety standards for the storage and handling of hazardous chemical substances and mixtures in everyday life.

- **Community Engagement:** Interpreting individual responsibility for biodiversity restoration and actively participating in community initiatives and ecological problem-solving.

The advanced objectives for environmental education include the following competencies:

- **Institutional Analysis:** Identifying information resources related to environmental preservation; analyzing the specific tasks and roles of governmental institutions and non-governmental organizations (NGOs) engaged in environmental protection.

- **Personal Accountability:** Analyzing personal responsibility and the individual ecological footprint as factors in nature conservation.

- **Pollution Data Analysis:** Analyzing data concerning the degradation of air quality caused by transport, industry, and domestic activities.

- **Pollutant Differentiation:** Distinguishing key air pollutants—particulate matter (PM), sulfur and nitrogen oxides (SO_x and NO_x), tropospheric ozone—as well as specific contaminants like hydrogen sulfide, ammonia, volatile organic compounds (VOCs), CFCs, etc.

- **Soil Contamination:** Presenting and differentiating various types of soil contamination and interpreting their effects on the environment and human health.

- **Water Management:** Modeling strategies, ideas, and projects aimed at preserving the ecological status of waters and water bodies.

- **Energy Resource Impact:** Utilizing public resource data on the potential consequences of energy extraction from various sources on the atmosphere and environment within project work.

- **Consumer Behavior and Climate Action:** Collaborating in teams to discuss ideas and participate in activities focused on changing consumer models to mitigate climate impact.

- **Climate Change Resilience:** Evaluating the effect of climate changes on ecosystems and the capacity to generate sustainable flows of food, energy, and water; clarifying the importance of climate adaptation and impact minimization.

- **Ecosystem Regeneration:** Defining ecological approaches for the regeneration and restoration of ecosystems.

- Conservation Networks: Classifying terms such as "transboundary protected area," "National Ecological Network," "Natura 2000," "European Natura 2000 Network," and "Peace Park."

- Biodiversity Threats: Interpreting the contribution of state reserves and parks to biodiversity conservation; defining and investigating anthropogenic threats leading to species loss and extinction.

- Circular Economy Concepts: Defining the concept of a product "life cycle" and analyzing diverse approaches to waste treatment and recycling; interpreting the notions of "circular economy," "green economy," and "blue economy."

Competencies in Waste Management and Civic Engagement:

- Waste Treatment Methodologies: Identifying fundamental approaches to waste processing, including landfilling, recycling, composting, and incineration; analyzing the respective advantages and risks of each treatment method.

- Strategic Waste Management: Drawing conclusions on source-separated waste collection as a primary management approach; discussing core principles such as "Prevention," the "Polluter Pays" principle, the "Precautionary" principle, and the "Proximity" principle.

- Institutional and Civic Procedures: Interpreting the procedures available to institutions and civil society for exercising collective commitment to environmental preservation.

- Proactive Engagement: Engaging in ecological initiatives and operational tasks dedicated to environmental conservation; demonstrating empathy and collaboration with diverse social entities to achieve Global Sustainable Development Goals (SDGs).

Proposed Program for the Greening of the "Technologies and Entrepreneurship" Curriculum

Program Objectives:

- Knowledge Expansion: Broadening and consolidating knowledge of natural objects, phenomena, and the human-nature relationship.

- Societal-Environmental Nexus: Developing skills to identify interdependencies between society and the environment.

- Problem-Solving: Applying diverse approaches to resolving ecological challenges.

- Empirical Learning Environment: Creating an optimal educational setting for empirical exploration of the natural world and satisfying student interest in scientific inquiries.

- Active Stewardship: Fostering a conscious, action-oriented relationship with the living environment.

- Cultural Formation: Cultivating eco-friendly habits and a robust ecological culture.

Program Tasks:

- Knowledge Enrichment: Enhancing understanding of nature, humanity, and the ecological crises arising from the anthropogenic pollution of the biosphere.

Final Competencies for the Curriculum Greening Program:

- **Resource Management & Legislation:** Studying industrial sectors involved in natural resource usage and developing a responsible attitude toward adhering to the "Law on the Inexhaustibility of Natural Resources" [Note: This specific law title may be a conceptual term used within the program's context, rather than a universal legal act].

- **Biodiversity Awareness:** Awareness of extinct and protected species of flora and fauna.
- **Practical Stewardship:** Developing skills for environmental care and protection.
- **Inquiry Skills:** Forming practical competencies and habits for tracking, detailed investigation, and drawing conclusions during practical activities and projects.

Key Directions Integrating Ecological Culture into Technologies and Entrepreneurship:

The implementation of environmental culture within the *Technologies and Entrepreneurship* curriculum should integrate several crucial directions:

- **Individual Agency:** Emphasizing the decisive function of every individual in building a sustainable model for a healthy and safe ecosystem.

- **Action Orientation:** Students must be encouraged to act and participate actively.

- **Life Competencies:** Prioritizing essential life skills, such as overcoming problematic situations and making reasoned, ethical choices.

- **Strategic Thinking:** Understanding the strategic role of a positive attitude towards nature.

- **Global Responsibility:** The need for everyone to take responsibility not only for themselves but also for the natural environment on a global scale.

- **Health Nexus:** Recognizing the direct link between personal health and a healthy environment.

- **Complexity of Issues:** Understanding the multitude of factors influencing ecological problems.

- **Eco-Conscious Choice:** Ensuring learners can make environmentally responsible choices.

Program Context and Methodology:

The execution of this program requires the mastery of specific ecological concepts, tailored to the students' age characteristics and aligned with the curriculum's specific learning objectives.

The development of this program was necessitated by a deficit in professional competencies regarding the integration (greening) of environmental content and concepts within general school subjects. This deficit is further substantiated by the results of an anonymous survey detailed below. The methodology is implemented using a reflective approach and stimulates the creation of foundational ecological culture.

The survey was conducted among 59 primary and lower secondary school teachers from the city of Shumen.

ECOLOGICAL LITERACY SURVEY (Questionnaire)

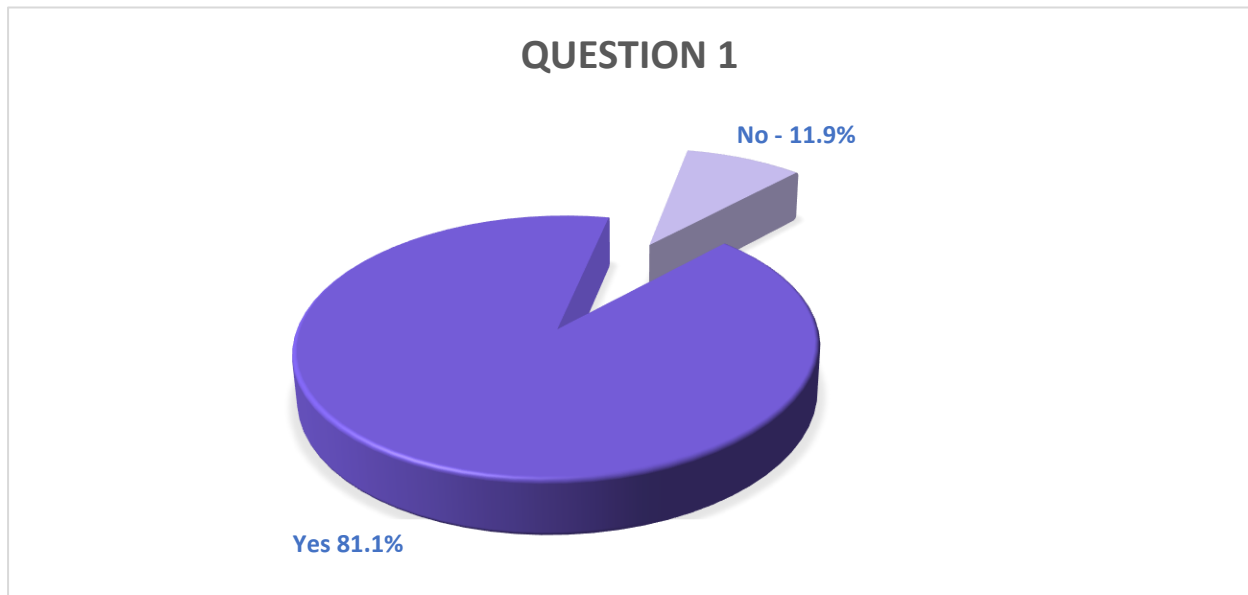
1. Do you introduce students to the concept of "waste," the different types of waste, and methods for reducing its quantity?

2. Are the principles of a healthy lifestyle integrated into the "Technologies and Entrepreneurship" training?
3. Are you familiar with the Sustainable Development Concept of the Republic of Bulgaria?
4. Are the students familiar with the concept of the "greenhouse effect"?
5. Are the students aware of the "principle of shared responsibility"?
6. Do the issues of the global ecological crisis find a place in your teaching practice?
7. Are the students informed about environmentally hazardous substances?
8. Do the students master the rules for safe handling of various materials?
9. Is sufficient attention paid to ecological concepts within the "Technologies and Entrepreneurship" curriculum?
10. What is your professional opinion on environmental protection issues?
11. Are the students aware of the problems caused by anthropogenic pollution of the environment?
12. Do you utilize the Law of Biosphere Reversibility and the Law of Natural Resource Exhaustibility in your pedagogical work?

Number of respondents: 59					
Question №	Yes (Count)	Yes (%)	No(Count)	No (%)	All
1	52	88.1	7	11.9	59
2	54	91.5	5	8.5	59
3	42	71.2	17	28.8	59
4	43	72.9	16	27.1	59
5	32	54.2	27	45.8	59
6	52	88.1	7	11.9	59
7	14	23.7	45	76.3	59
8	51	86.4	8	13.6	59
9	37	62.7	22	37.3	59
10	48	81.4	11	18.6	59
11	57	96.6	2	3.4	59
12	15	25.4	44	74.6	59

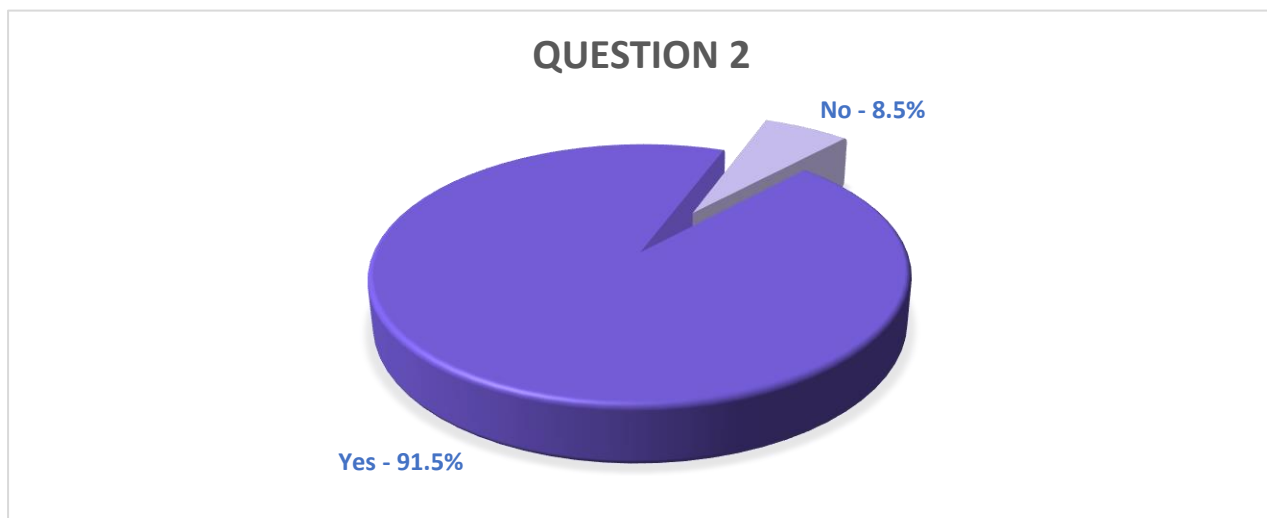
Question 1: Do you introduce students to the concept of 'waste', the different types of waste, and methods for reducing waste quantities?

Answers	Number of respondents	Percentage (%)
Yes	52	88.1%
No	7	11.9%
All	59	100.0%



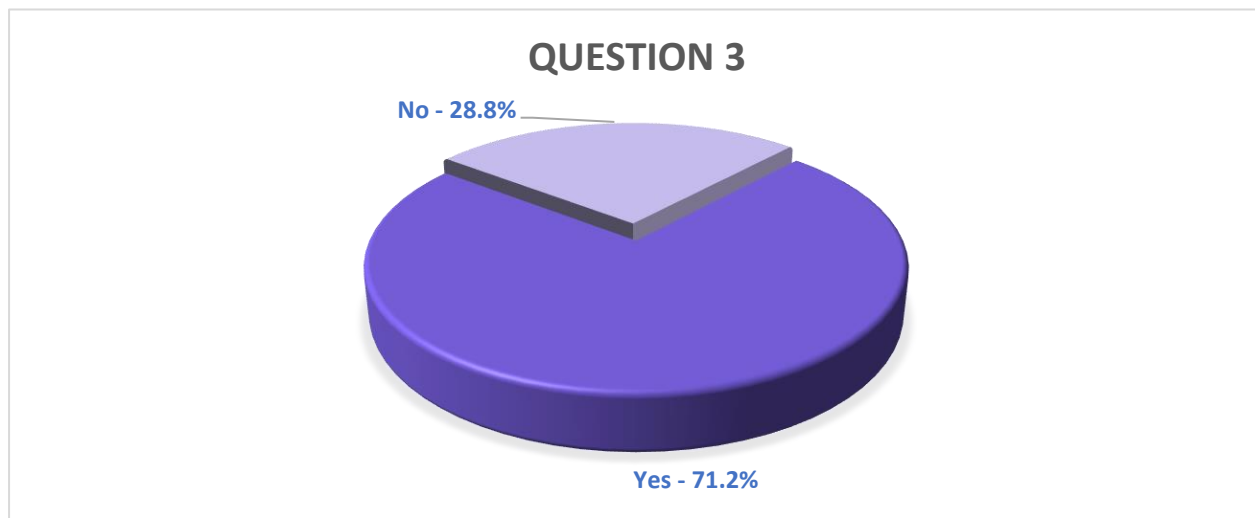
Question 2: Do the principles of a healthy lifestyle find a place in Technologies and Entrepreneurship education?

Answers	Number of respondents	Percentage (%)
Yes	54	91.5
No	5	8.5
All	59	100.0



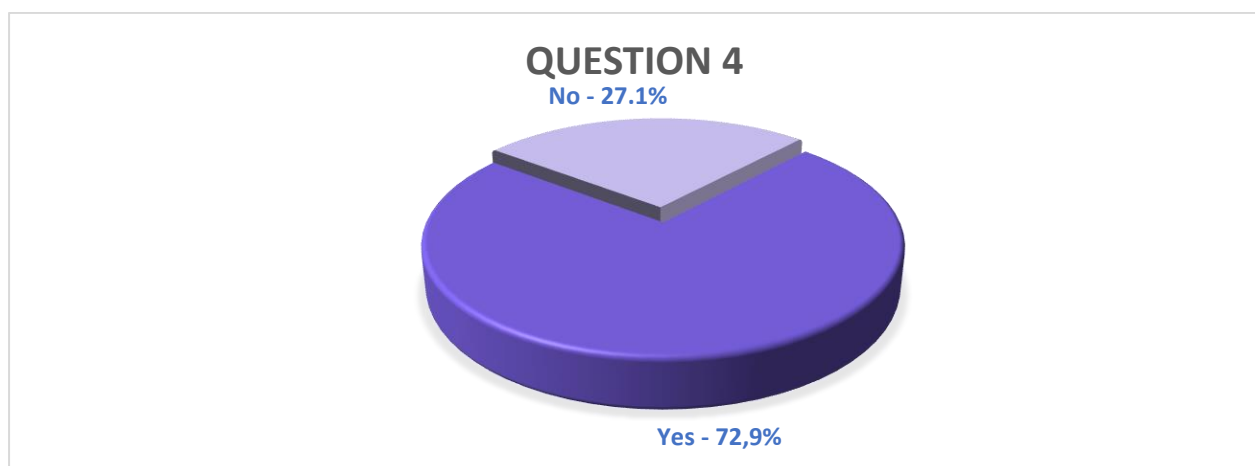
Question 3 Are you familiar with the Concept for Sustainable Development in the Republic of Bulgaria?

Answers	Number of respondents	Percentage (%)
Yes	42	71.2%
No	17	28.8%
All	59	100%



Question 4 Are students acquainted with the 'greenhouse effect' concept?

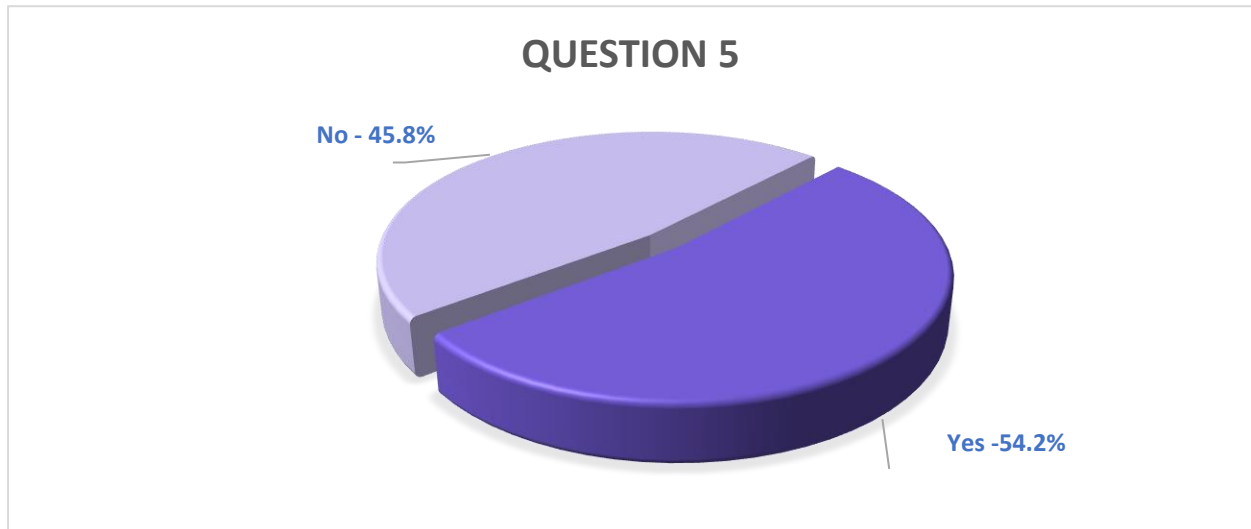
Answers	Number of respondents	Percentage (%)
Yes	43	72.9
No	16	27.1
All	59	100.0



Question 5 Are students acquainted with the 'concept of shared responsibility'?

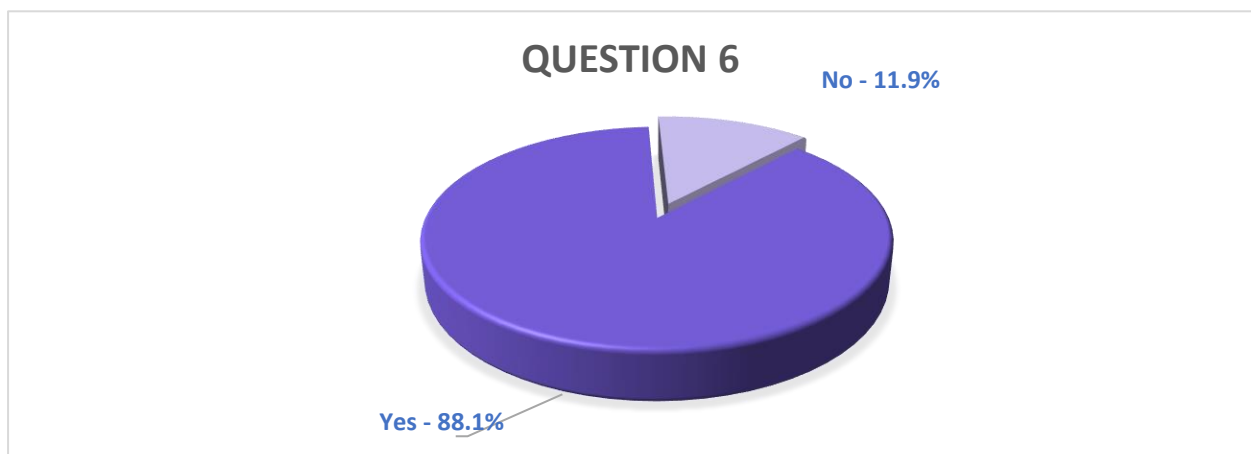
Answers	Number of respondents	Percentage (%)
---------	-----------------------	----------------

Yes	42	71.2%
No	17	28.8%
All	59	100%



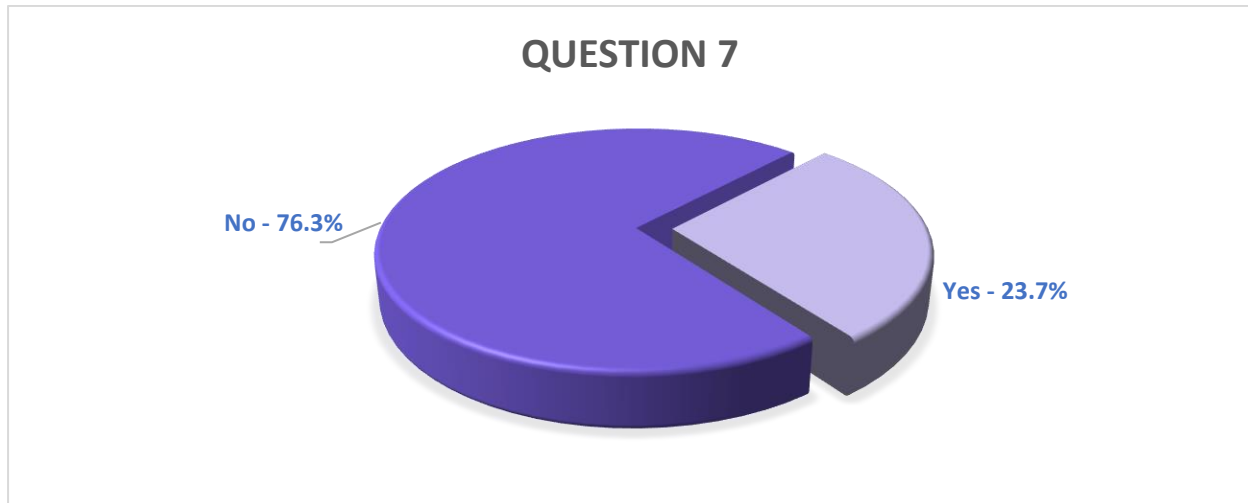
Question 6 Are the issues related to the global ecological crisis addressed within your teaching activities?

Answers	Number of respondents	Percentage (%)
Yes	52	88.1
No	7	11.9
All	59	100.0



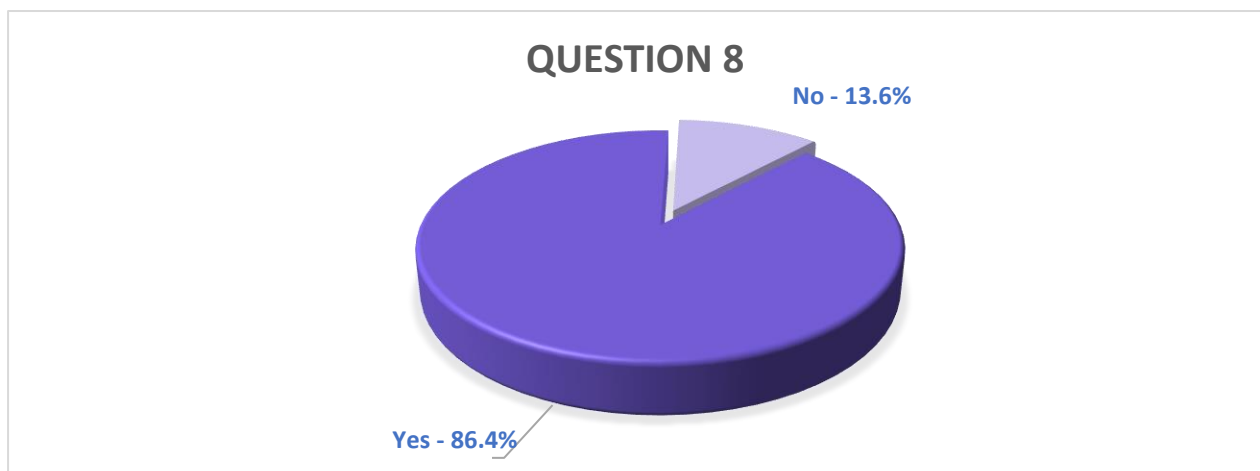
Question 7 Are students aware of ecotoxic or environmentally harmful substances?

Answers	Number of respondents	Percentage (%)
Yes	14	23.7
No	45	76.3
All	59	100.0



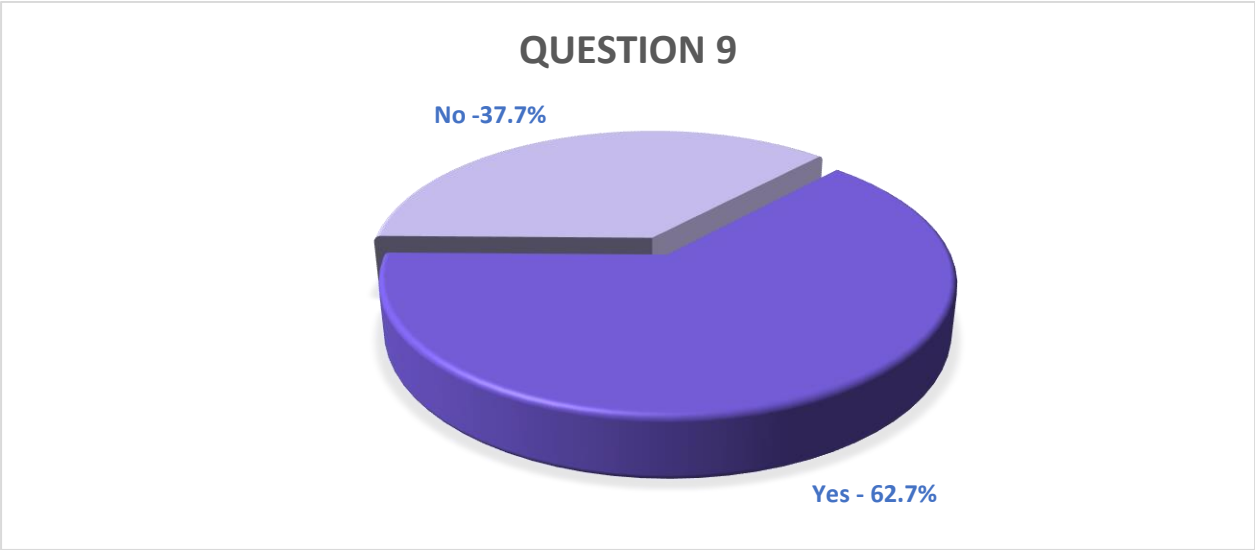
Question 8 Do students follow safety protocols for working with different substances and materials?

Answers	Number of respondents	Percentage (%)
Yes	51	86.4
No	8	13.6
All	59	100.0



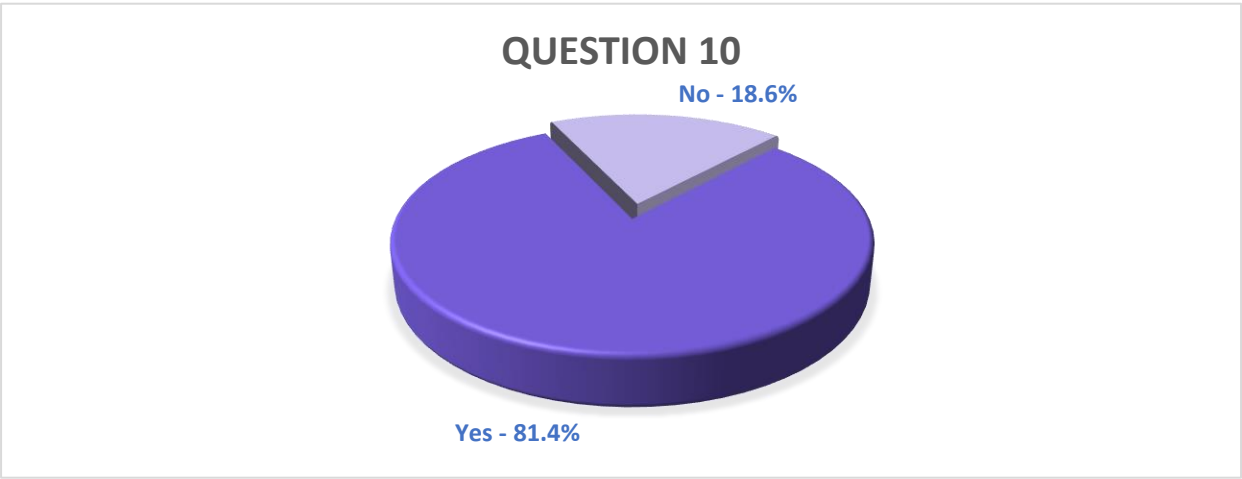
Question 9 Do you focus on environmental concepts in your Technology and Entrepreneurship classes?

Answers	Number of respondents	Percentage (%)
Yes	37	62.7
No	22	37.3
All	59	100.0



Question 10 What is your stance on the problems of environmental conservation?

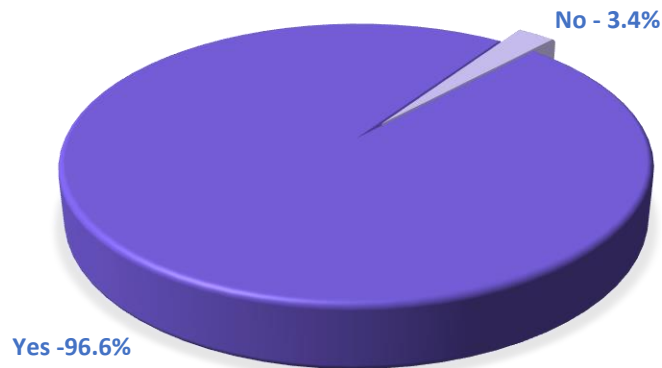
Answers	Number of respondents	Percentage (%)
Yes	48	81.4
No	11	18.6
All	59	100.0



Question 11 Are students aware of the impact of anthropogenic pollution on the environment?

Answers	Number of respondents	Percentage (%)
Yes	57	96.6
No	2	3.4
All	59	100.0

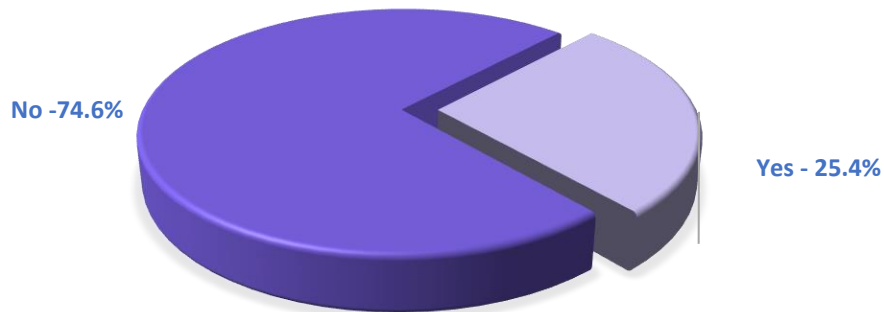
QUESTION 11



Question 12 Do you apply the Law of Biosphere Reversibility and the Law of Finite Natural Resources in your pedagogical practice?

Answers	Number of respondents	Percentage (%)
Yes	15	25.4
No	44	74.6
All	59	100.0

QUESTION 12



"The responses to the first question indicate that nearly all surveyed teachers (88.1%) are familiar with the concept of 'waste.' Similarly, the results from the second question demonstrate that knowledge regarding waste recycling is at a professional level (91.5%).

Unexpectedly, only 71.2% of the respondents are acquainted with the Sustainable Development Concept of the Republic of Bulgaria. More concerning is the relatively high proportion of educators—72.9%—who are unfamiliar with the 'greenhouse effect,' a finding that

is surprising given the widespread media coverage of the topic. Furthermore, the technicalities of plastic waste recycling are not sufficiently understood, with a familiarity rate of only 54.2%.

While results regarding methods for waste reduction are relatively positive (88.1%), there is a significant lack of knowledge concerning specialized terminology. Specifically, the term 'xenobiotics' is poorly recognized, with only 23.7% of teachers providing correct answers.

Conversely, the surveyed educators demonstrate a high level of awareness regarding the harmful effects of GMOs on human health (86.4%). However, the results regarding 'acid rain' are perplexing, as only 62.7% of respondents could correctly explain this widely discussed phenomenon. Finally, there is a low level of familiarity with toxic metals (81.4%), suggesting a broader lack of knowledge regarding the primary pollutants of the biosphere."

"A positive impression is made by the responses to the eleventh question, which demonstrate that educators have mastered the concept of 'environmental education' and are well-acquainted with its objectives (96.6%).

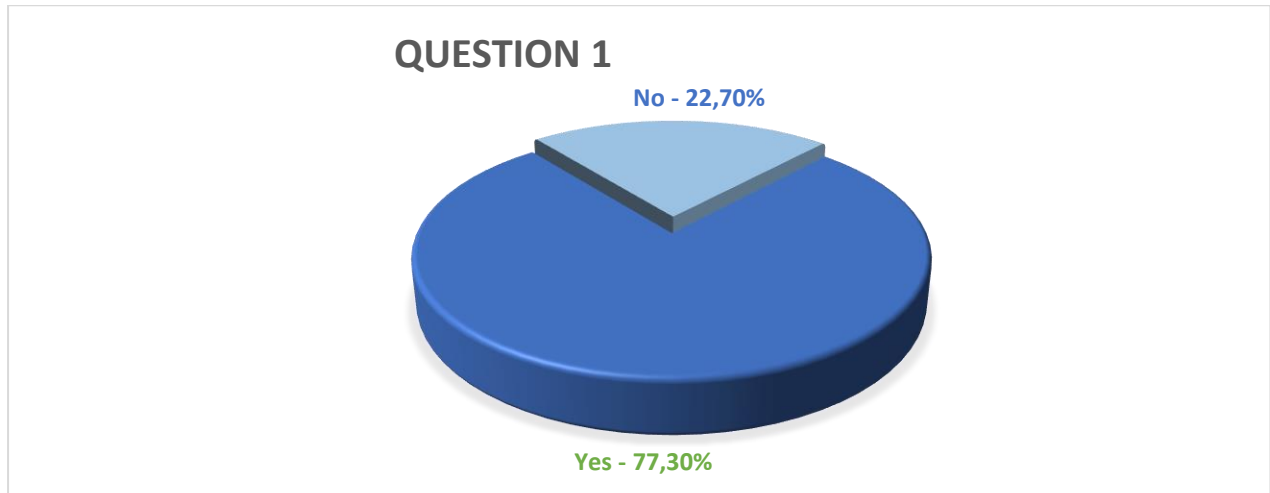
Inexplicably, however, the results of the twelfth question show that only 25.4% of the respondents are familiar with the term 'ecological crisis.' This phenomenon, often described as the 'slow but certain death of the planet,' is a subject of daily discussion in modern society and a focus of significant governance and media attention.

In conclusion, it can be inferred that regarding the socio-ecological literacy of teachers, there is a substantial need for further advancement. This underscores the evident relevance of the present doctoral dissertation. This fact is further substantiated by the objectives concerning the pedagogical technology for greening the curriculum in the subject Technologies and Entrepreneurship.

The findings indicate that teachers' socio-ecological literacy requires the provision of supplementary information to facilitate pedagogical interaction within Technologies and Entrepreneurship training, aimed at the cultivation of an ecological culture.

Pedagogical interaction in education is a key socio-psychological mechanism for the optimal achievement of educational goals. It is defined primarily as a social type of interaction, given the multiple social positions of the subjects involved. Through their pedagogical functions, the teacher demonstrates and establishes new behavioral models. The rules of teacher-student interaction are socially and normatively regulated, serving as a powerful regulator in the implementation of the diverse pedagogical situations that constitute the interaction process." Based on the survey conducted among 22 teachers of 'Technology and Entrepreneurship', the results are as follows:

Question 1: Are innovation-related competencies included in the curricula?

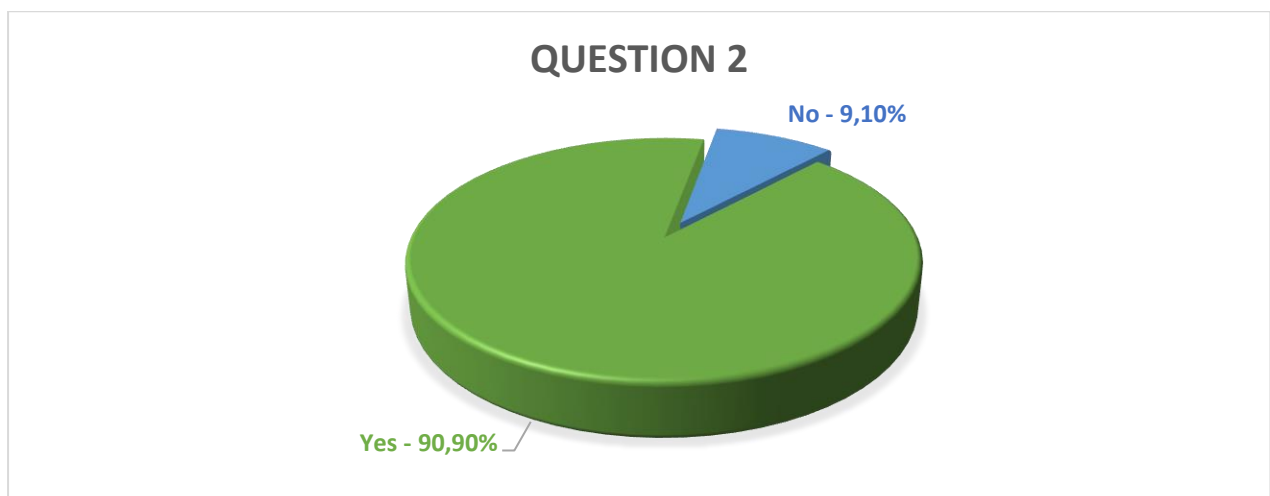


"The responses to the first question confirm that competencies in the field of innovation are reflected in the curricula, as reported by 77.3% of the participants.

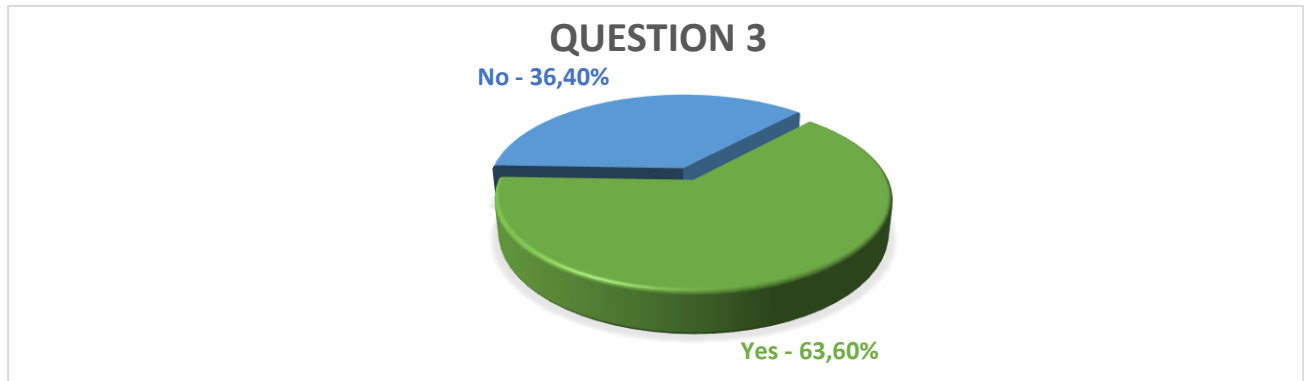
In this regard, the results of the second question demonstrate that innovation-related competencies are actively developed within the framework of individual subjects, including the subject of Technologies and Entrepreneurship.

However, a significant gap remains in the organizational structure of schools: 36.4% of respondents indicate that there are still no designated teachers or staff members specifically assigned the responsibility of overseeing the development of competencies in innovation and entrepreneurship.

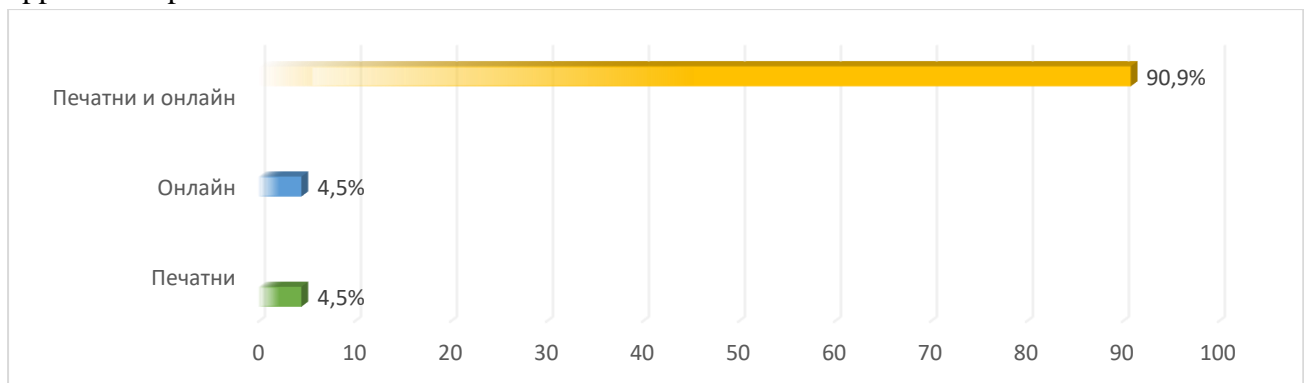
Question 2: Are competencies in the fields of innovation and entrepreneurship developed within the framework of individual subjects?"



Question 3: Is there a designated teacher responsible for developing competencies in the fields of innovation and entrepreneurship within the school?

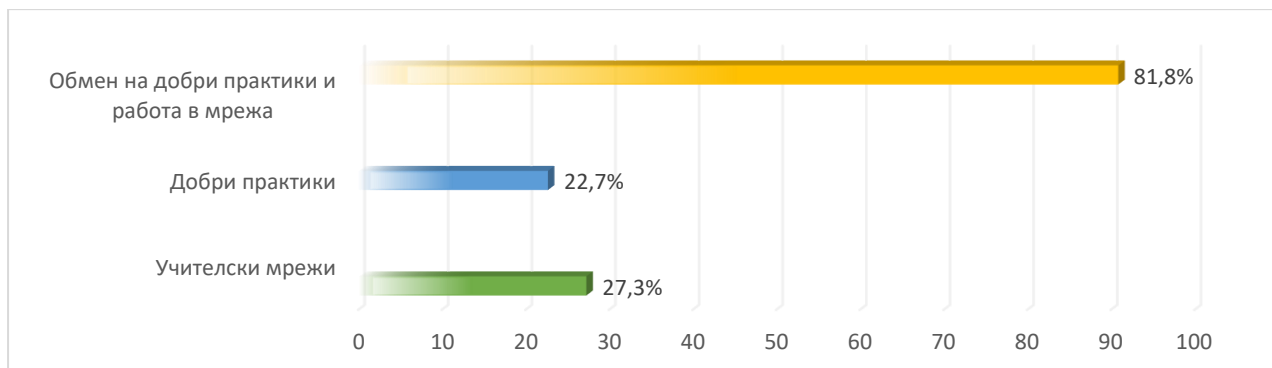


Question 4: What types of instructional materials do you utilize in your practice? Select all applicable options



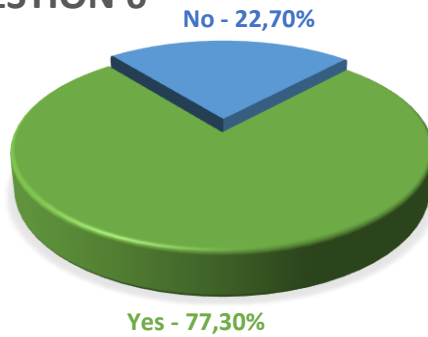
It is noteworthy that a vast majority of Technologies and Entrepreneurship teachers (90.9%) utilize both printed and online instructional materials in their direct practice.

Regarding accessible resources for supporting innovation in school entrepreneurship, the results highlight the significance of teacher networks (27.3%) and the implementation of established best practices (22.7%). Notably, the exchange of best practices and professional networking (81.8%) emerges as a primary resource, which further demonstrates the high level of competence among educators in the field of Information and Communication Technologies (ICT).



Question 6: Do you have the opportunity to participate in short online courses and seminars for teachers on this topic?

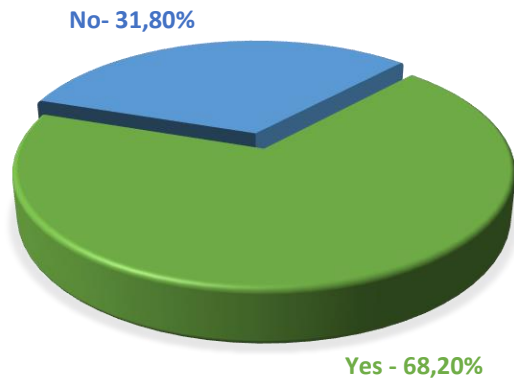
QUESTION 6



It is commendable that 77.3% of educators have the opportunity to participate in online courses and seminars related to the subject matter of Technologies and Entrepreneurship.

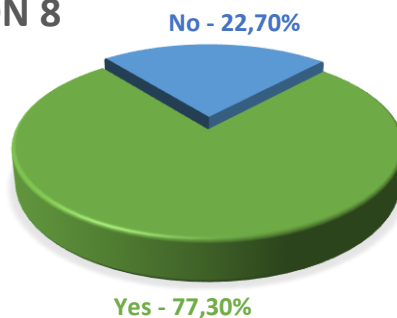
Question 7: Do you establish partnerships with organizations, associations, or private companies?

QUESTION 7



Question 8: Do you participate in national projects and competitions aimed at developing competencies in the fields of innovation and entrepreneurship?

QUESTION 8

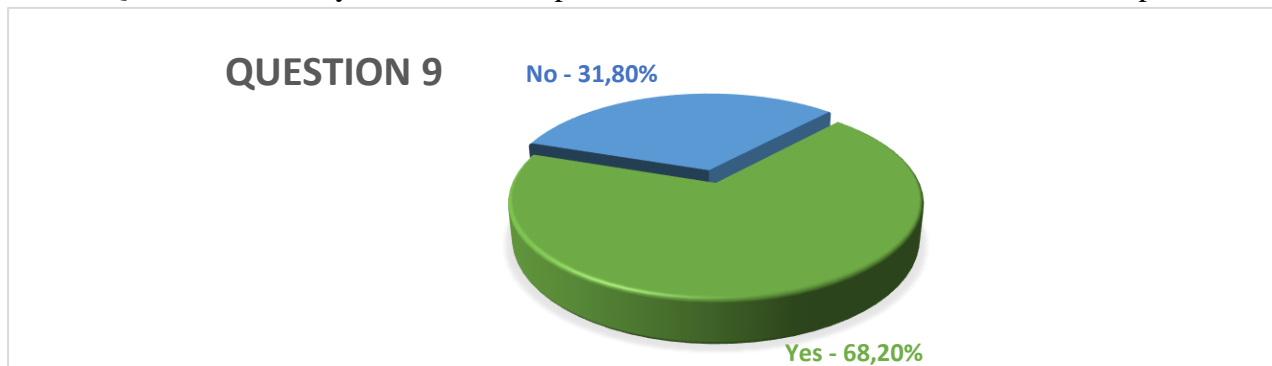


Educators in Technologies and Entrepreneurship do establish partnerships with businesses, but the extent of this collaboration is insufficient (31.8%).

Participation in national projects and competitions aimed at developing competencies in innovation and entrepreneurship is also not at the required level (22.7%).

Furthermore, entrepreneurs are still infrequently invited into the classroom to share their experience (31.8%).

Question 9: Do you invite entrepreneurs into the classroom for shared experience?

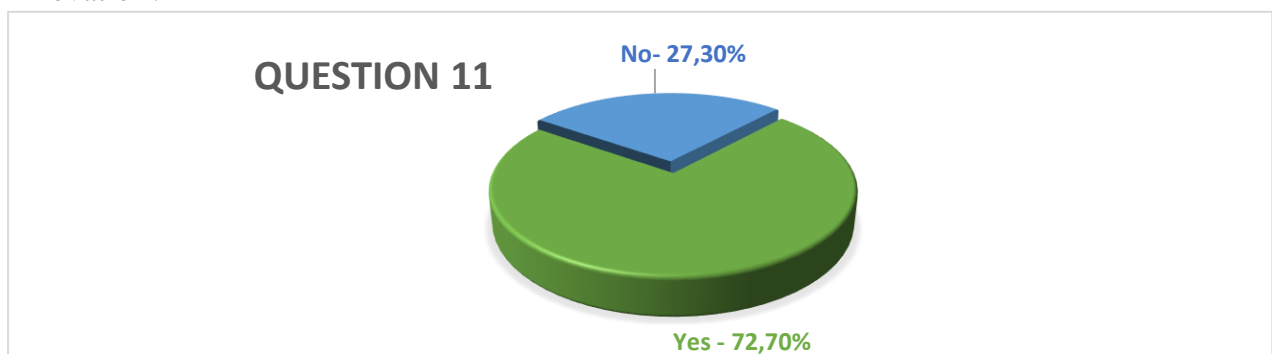


Question 10: Do you utilize audio-visual content related to entrepreneurship and innovation in your practice?



It is commendable that audio-visual technologies occupy a significant place in the practice of educators, with a utilization rate of 90.9%.

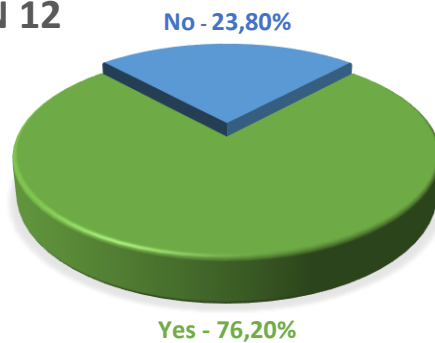
Question 11: Do your students participate in competitions related to entrepreneurship and innovation?



A small number of students participate in competitions related to innovation and entrepreneurship, accounting for only 27.3% of those surveyed.

Question 12: Do you collaborate with local employers and companies?

QUESTION 12

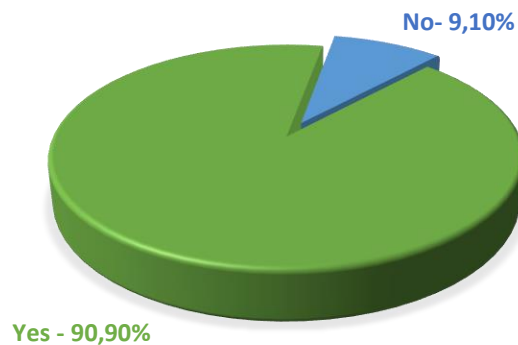


Only 23.8% of the surveyed teachers collaborate with local employers and companies. Furthermore, the potential involvement of parents in the instructional process is practically neglected, with a utilization rate of only 9.1%.

Collaboration with both Vocational Guidance Centers (45.5%) and the Regional Management of Education in the field of Technologies and Entrepreneurship (50.0%) remains below the required level.

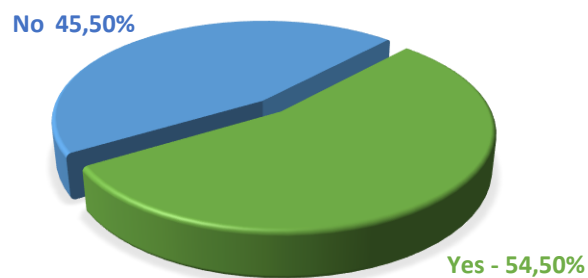
Question 13: Do you involve parental associations in your professional practice?

QUESTION 13

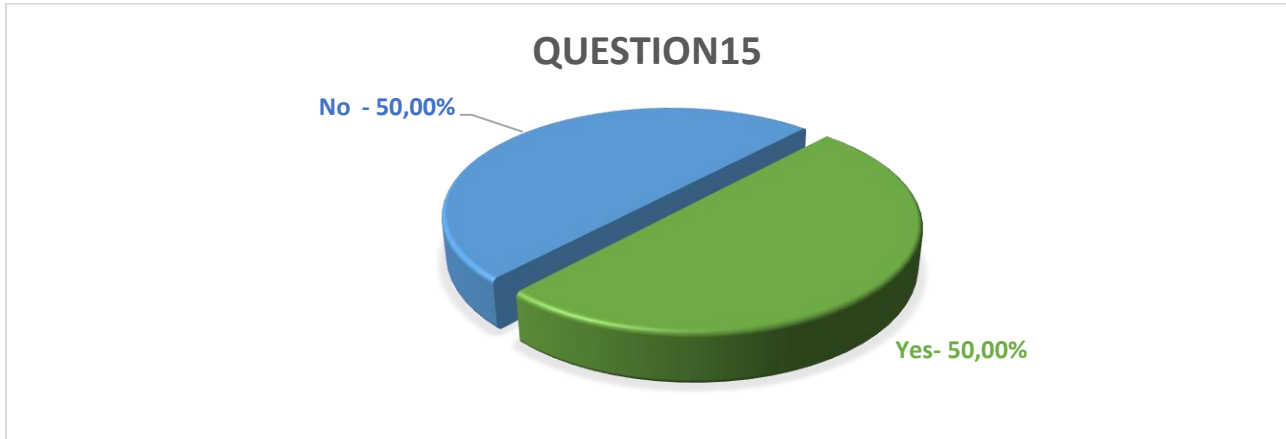


Question 14: Do you collaborate with Vocational Guidance Centers?

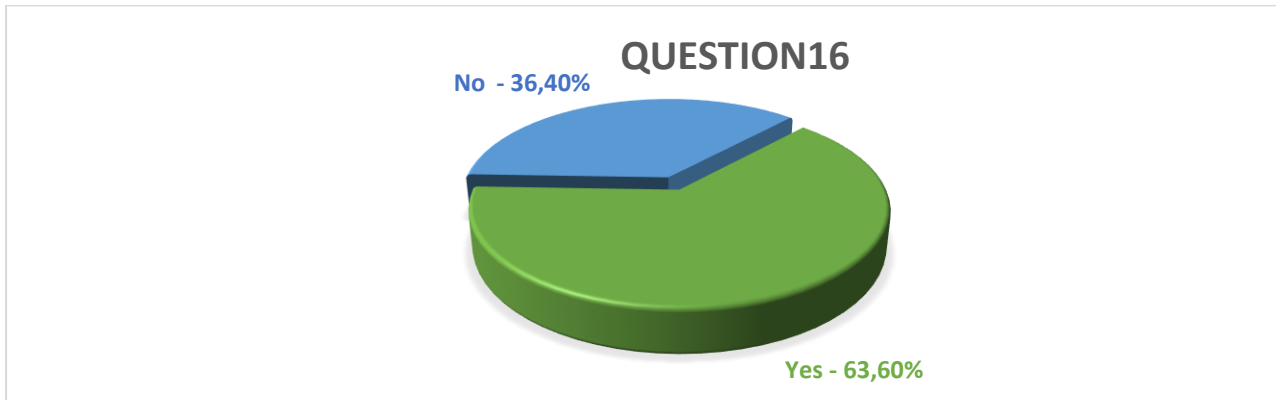
QUESTION 14



Question 15: Do you collaborate with the Regional Management of Education (RME) in the fields of innovation and entrepreneurship?



Question 16: Do you have students who participate in research projects?



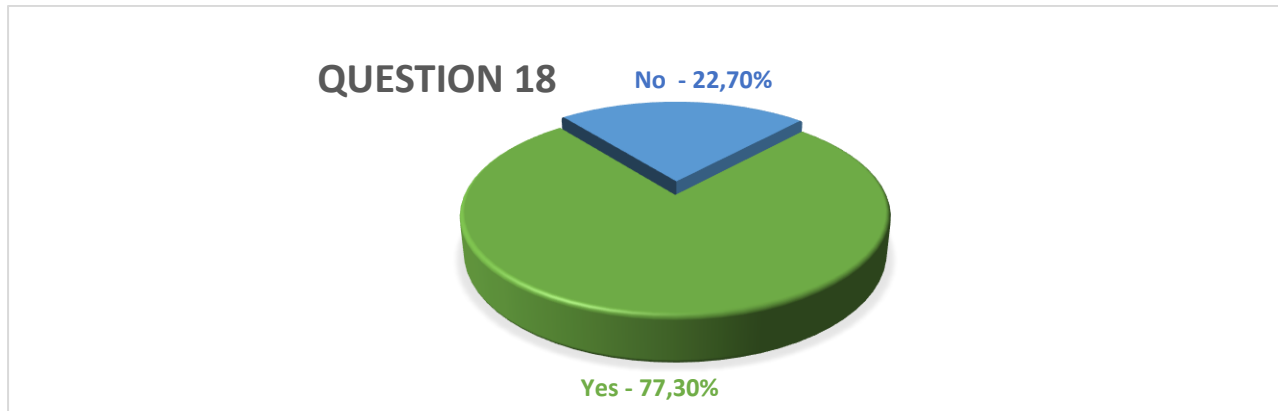
The number of students involved in research projects remains low, at only 36.4%. However, there is a profound sense of ambition and a 100% commitment among the surveyed educators toward continuous professional development and qualification enhancement.

Question 17: Which are the most effective extracurricular forms you utilize to develop students' competencies in innovation and entrepreneurship?

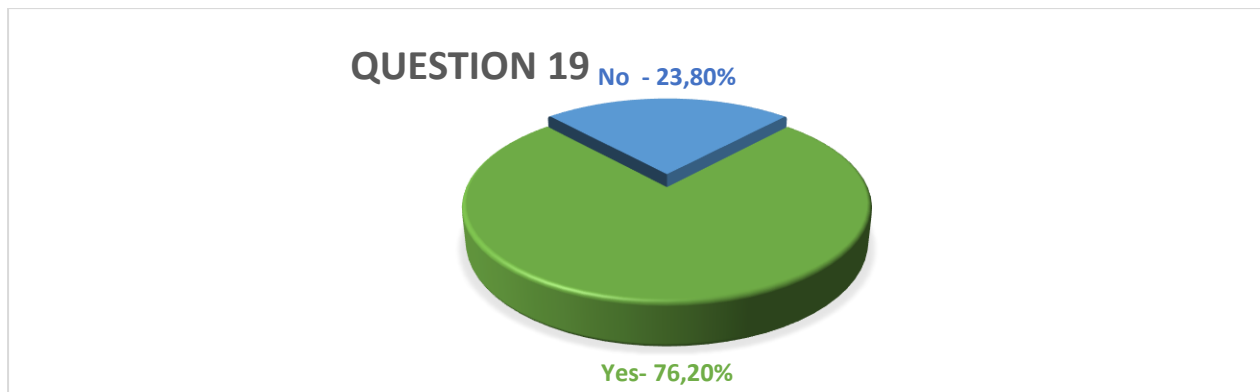
The open-ended responses identified the following:

- Project-based work and national projects;
- Research projects and specialized programs;
- Inquiry-based learning (observations) and interest-based clubs;
- Practical experience and meetings with business representatives/entrepreneurs;
- Competitions, bazaars, and exhibitions;
- *Note: Several respondents indicated a lack of such forms within their schools.*

Question 18: Do you participate in National projects and competitions for the development of competencies in innovation and entrepreneurship?



Question 19: Does your school or do you personally participate in European competitions in the fields of innovation and entrepreneurship?



Teacher participation in National (22.7%) and European projects (23.8%) within the fields of innovation and entrepreneurship remains below the necessary threshold. Notwithstanding these figures, it is an undeniable fact that the educational system—and specifically the field of Technologies and Entrepreneurship—is staffed by highly qualified educators possessing high social intelligence and a profound mastery of regulatory frameworks, scientific pedagogical information, and modern educational technologies.

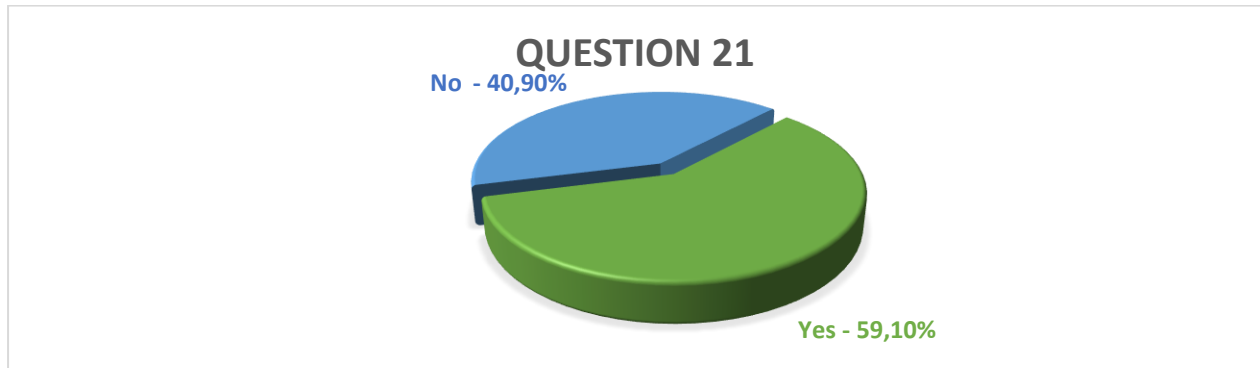
Question 20: In your opinion, what are the most critical functions of 'Technologies and Entrepreneurship' education?

The respondents identified the following key functions:

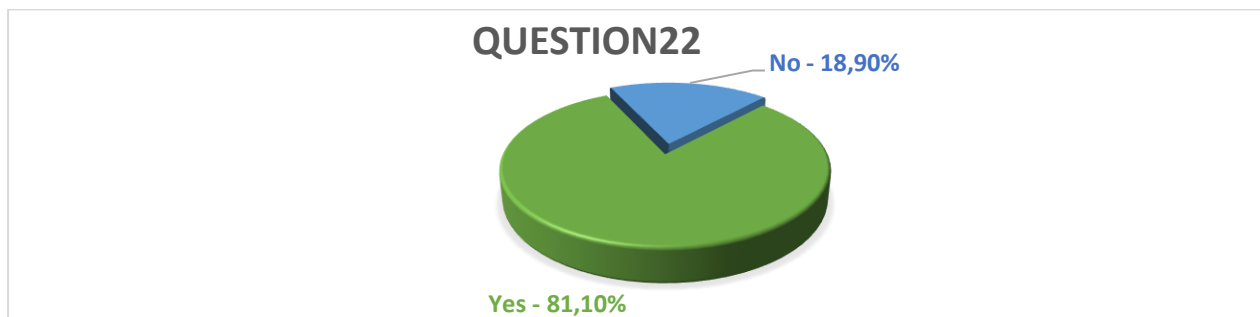
- Fostering initiative and an entrepreneurial spirit;
- Developing creativity, analytical skills, and critical thinking;
- Acquiring practical knowledge and skills applicable to real-life situations;
- Facilitating career guidance and effective labor market integration;
- Developing technological culture, precision, discipline, and teamwork;

Promoting independent thinking and social/civic competencies through project-based activities.

Question 21: Do you implement interdisciplinary approaches in your 'Technologies and Entrepreneurship' instruction?



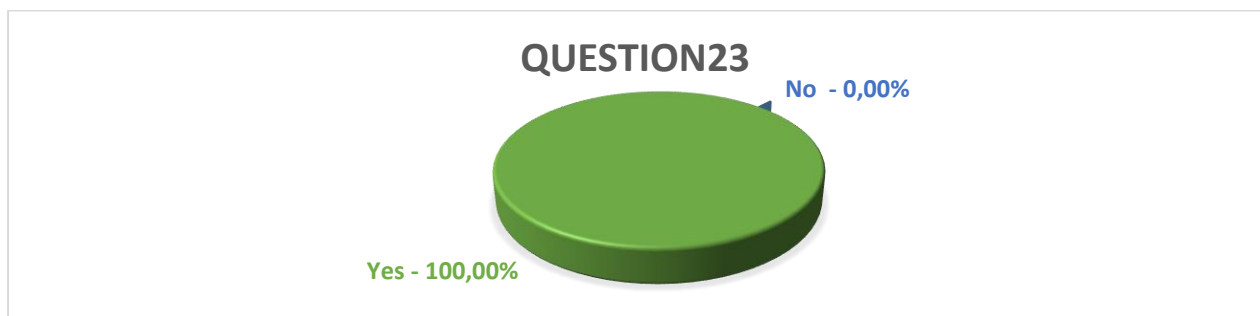
Question 22: Do you organize debates and role-playing games within the classroom?



In their direct practice, teachers of "Technologies and Entrepreneurship" organize debates and role-playing games (81.8%) and utilize interdisciplinary approaches in their instruction (59.1%). All educators teaching the subject "Technologies and Entrepreneurship" believe that this discipline contributes significantly to the development of students' analytical skills and critical thinking (100.0%).

The assessment of the respondents suggests that environmental protection and the understanding of the global ecological crisis are not yet at the center of attention for professionals in the educational system. This is attributed to the insufficient provision of appropriate instructional forms within the educational process (81.8%).

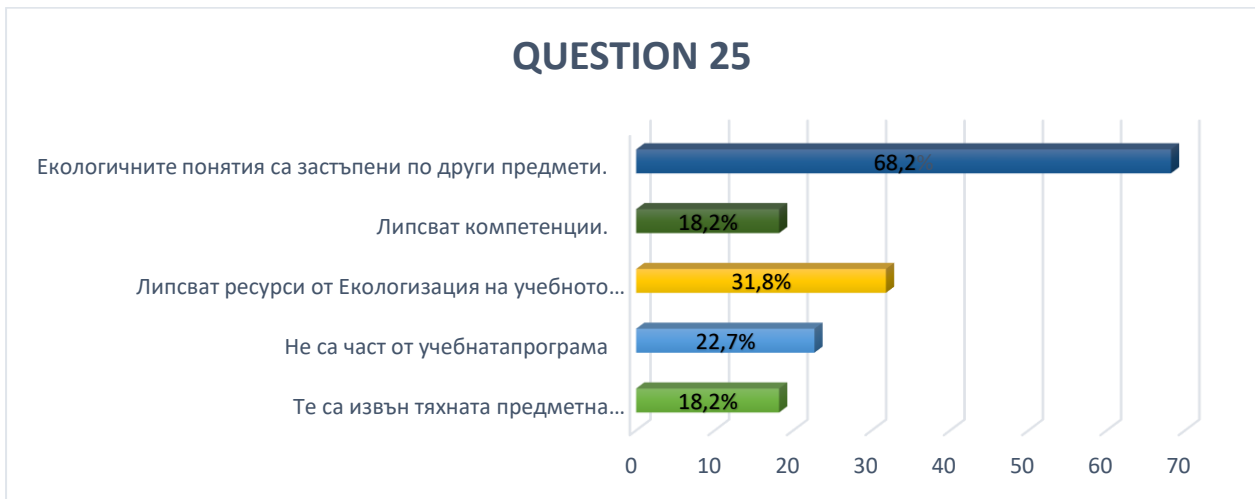
Question 23: In your opinion, does education in "Technologies and Entrepreneurship" contribute to the development of students' analytical skills and critical thinking?



Question 24: In your opinion, does the school provide students with the necessary classes and skills to understand the global environmental crisis and environmental protection?



Question 25: What are the reasons why teachers do not incorporate ecological concepts into their lessons?



Question 26: Does your school organize initiatives or campaigns related to environmental protection?



The reasons for the exclusion of environmental concepts from the "Technologies and Entrepreneurship" curriculum, according to the respondents, vary significantly:

They fall outside the scope of the subject matter (18.2%);

They are not part of the official state syllabus (22.7%);

There is a lack of resources regarding the "greening" (ecologization) of the educational content (31.8%);

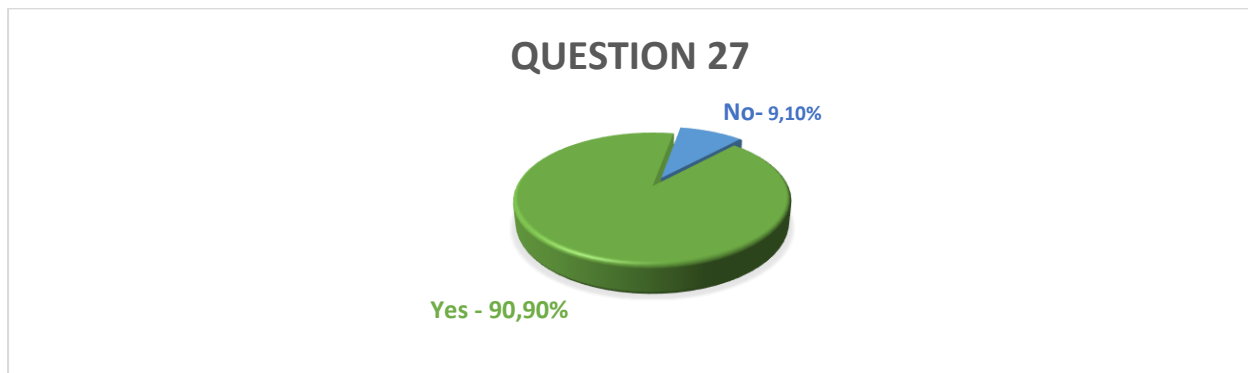
There is a perceived lack of professional competencies (18.2%);

Environmental concepts are already covered in other subjects (68.2%).

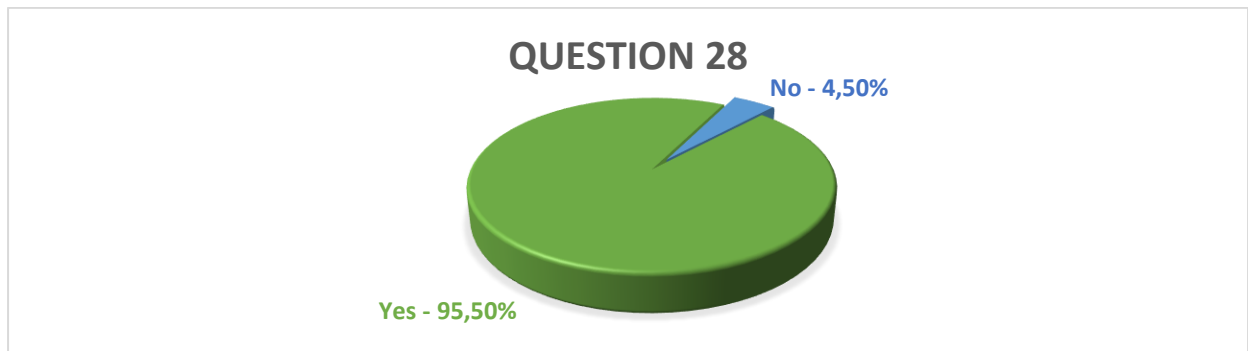
Notwithstanding the aforementioned data, a significant majority of schools (81.8%) conduct practical initiatives and campaigns related to environmental protection.

Furthermore, despite the opinion that information related to ecological concepts and health is adequately provided in other academic disciplines, 90.9% of the surveyed teachers report that they incorporate information on healthy nutrition within their "Technologies and Entrepreneurship" classes.

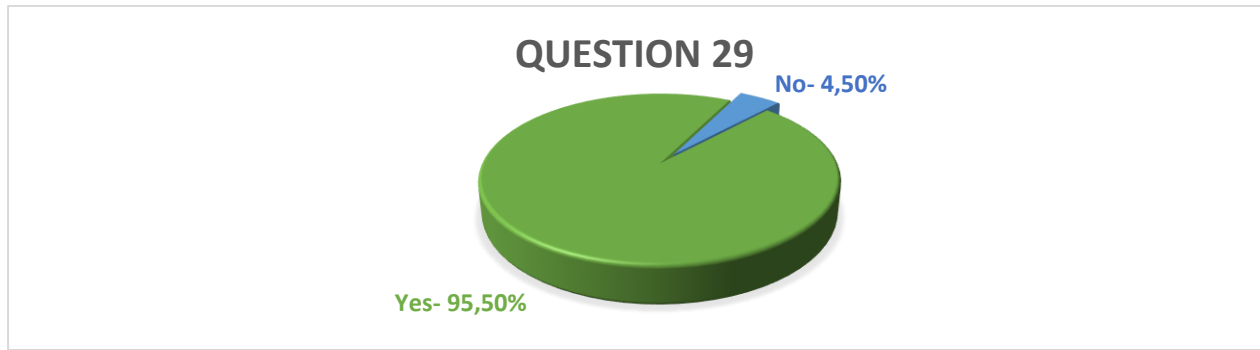
Question 27: Do you provide information on healthy nutrition during "Technologies and Entrepreneurship" classes?



Question 28: In your opinion, is there an opportunity within the "Technologies and Entrepreneurship" classes to discuss facts related to global anthropogenic pollution and environmental protection?



Question 29: Is there a possibility to integrate issues related to the global environmental crisis into the "Technologies and Entrepreneurship" curriculum?



Question 30: Do you believe that the "greening" (ecologization) of educational content should be regarded as a serious issue within the field of education in general?



Academic Translation

The surveyed teachers of "Technologies and Entrepreneurship" maintain that the curriculum allows for the integration of information regarding both global anthropogenic pollution and environmental protection (95.5%), as well as the broader global environmental crisis (95.5%).

Universally, all respondents identify the "greening" (ecologization) of educational content as a critical issue within the current educational system (100.0%).

In conclusion, the analysis of the survey results confirms the necessity of ecologizing the curriculum for the subject "Technologies and Entrepreneurship" and validates the relevance of the problem addressed in this doctoral dissertation.

These findings provide a substantive basis for proposing revisions to the "Technologies and Entrepreneurship" syllabi. The comprehensive analysis of the educational content, regulatory documents, and framework requirements for learning outcomes—both for "Technologies and Entrepreneurship" and for Environmental Education—coupled with the survey data, justifies the proposal to incorporate the following ecological concepts into the curriculum, while strictly adhering to the age-specific cognitive characteristics of the students:

FIRST GRADE

Abiotic factors

Living nature

Non-living nature
Plants
Abiotic factors in plants
Animals
Waste
Waste segregation
Sustainable development

SECOND GRADE

Living nature
Non-living nature
Nature conservation
Anthropogenic pollution
Waste Waste segregation
Paper recycling
Plastic recycling
Organic farming
Wind turbines (Household energy sources and air pollution resulting from the combustion of wood or coal.)
Alternative energy sources

THIRD GRADE

Living nature
Non-living nature
Natural resources
Anthropogenic pollution
Water purity conservation
Air purity conservation
Greenhouse effect
Acid rain
Housing ecology
Electromagnetic field of operating household appliances
Waste segregation
Recycling of glass, metal, and plastic
Healthy nutrition
Mobile phones and health effects
Alternative energy sources – sun, wind, and water

FOURTH GRADE

Household appliances and health

Healthy nutrition
Narcotics and intoxicants and their harmful effects
Waste
Waste segregation
Methods for waste reduction
Recycling of paper, metals, glass, and metallic waste Sustainable development
Alternative energy sources
Greenhouse gases and the greenhouse effect
Organic farming
Environment
Natural environment
Environmental protection
Aluminum: properties and effects on human health
Mobile phones and health effects
Computers and harmful health effects
Biosphere pollution by oil, gas, and coal
The law of inexhaustibility of natural resources

FIFTH GRADE

Anthropogenic electromagnetic field (EMF) /mobile phone, computers, washing machine, electric stove/
Anthropogenic pollution of air, soil, and water
Healthy nutrition
Food additives
Carbonated drinks, chips, confectionery, food additives – harms and aggression
Substances contained in food that are harmful to health
Natural resources /exhaustible and inexhaustible/
Biofuels
Sustainable development
Harmful effects of operating household appliances (noise, electromagnetic field)
Mercury. Effects of mercury on human health
Waste
Waste segregation
Recycling
Ecological approach

SIXTH GRADE

Waste
Recycling of metallic waste
Ecological balance
Alternative energy sources

Metals and biosphere pollution with them
Household cleaning products and their harmful effects on human health
Artificial fertilizers and biosphere pollution
Pesticides and their harmful effects on health
Acid rain
Greenhouse effect
Ecological problem
Organic farming
Environmental pollution by wastewater
Noise pollution
Biosphere pollution from energy sources – gas, coal, wood
Computers and health effects
The law of inexhaustibility of natural resources

SEVENTH GRADE

Anthropogenic electromagnetic field (EMF) (mobile phone, computer)
Noise pollution
Ecological farm management
Organic farming
Artificial fertilizers. Soil pollution by cadmium and nitrates
Pesticides and effects on human health
GMO (Genetically Modified Organisms)
Growth stimulants
Anthropogenic pollution of soil, water, and air
Sources of pollution and types of pollutants

GLOSSARY OF ECOLOGICAL CONCEPTS IN TECHNOLOGIES AND ENTREPRENEURSHIP EDUCATION

A

Abiotic factors – the entire complex of elements within non-living nature that directly or indirectly influence organisms (light, temperature, moisture, climate, topography, water quality, air, soil, altitude, etc.); abiotic factors are the factors of the inorganic environment (temperature, humidity, light).

Aluminum (Al) – a chemical element in the main subgroup of Group III of the Periodic Table. A silver-white metal with high electrical and thermal conductivity. Its extraction from bauxite ore poses significant challenges to the geosphere. The byproduct of its processing ("red mud") is rich in iron, silicon, and titanium oxides; however, it holds little practical interest and serves as a severe pollutant. Aluminum is widely used in the production of light alloys, the extraction of certain metals, and the manufacturing of chemical apparatus and household utensils. Aluminum powder is utilized in lithographic inks and the preparation of explosives. Aluminum alloys are extensively applied in the aerospace and automotive industries. Massive inhalation of

aluminum dust damages the lungs, potentially leading to pneumonia and mucosal impairment. Workers in such environments may develop the so-called "aluminum lung." This occupational disease is characterized by irreversible changes in the respiratory tract and lungs, resulting in pulmonary fibrosis. Progressive encephalopathy has been documented in workers operating aluminum smelting furnaces. Water-soluble aluminum salts, when entering the body parenterally, are highly toxic and can pose a danger to the patient. Encephalopathy, anemia, osteomalacia, and bone alterations are observed only in the presence of excessive amounts of aluminum in the body.

Anthropogenic object – an object created by humans to satisfy social needs, which does not possess the inherent properties of natural objects.

Anthropogenic emission – the discharge of harmful substances resulting from human activity.

Anthropogenic emergency – an emergency situation arising as a consequence of erroneous human actions.

Anthropogenic succession – a sequential change of biocenoses occurring successively within a given biotope as a result of economic human activity and the direct or indirect influence of humans on the ecosystem (e.g., deforestation, construction, drilling, etc.).

Anthropogenic factors – the totality of all human activities that lead to direct changes in organisms and their communities or indirect changes caused by alterations in their surrounding environment.

Anthropogenic pollution – pollution arising as a result of human activity, including direct or indirect influence on the intensity of natural pollution (accidents, catastrophes at industrial sites involving the release of radioactive, chemical, and biological substances; pollution resulting from the economic activities of companies, transport, construction, ports, and urban development). It involves physicochemical or other changes in air quality that exceed established standards for harmful environmental impact, posing a threat to human health, flora and fauna, and material assets.

B

Biotic ecological factors – various influences on living organisms caused by surrounding beings (intraspecific and interspecific relationships – such as predation, parasitism, etc.); the influence of living organisms on natural processes.

Biotope (from *bio-* and Greek *topos* – place) – the territory defined by its environmental conditions – atmosphere, soil, microclimate, solar radiation, etc. The non-living component of an ecosystem – the environment inhabited by organisms, characterized by uniform living conditions. A specific area of the environment occupied by organisms where homogeneous conditions for existence prevail.

Biocenosis (from Greek *bios* – life and *koinos* – common) – a community (totality) of living organisms inhabiting a given biotope. The organic composition of an ecosystem – the assemblage of animals and plants occupying a specific area (biotope), i.e., interconnected populations of different species cohabiting a given territory. A self-sustaining, self-regulating system consisting of specific species, within which the cycling of matter and energy occurs. Its

structure includes: abiotic inorganic substances, autotrophic organisms, heterotrophic organisms, and detritivores.

Carbon dioxide (CO₂) – (Chem.) – the anhydride of carbonic acid; a colorless, non-flammable gas with a slightly acidic taste; suffocating and does not support combustion. This gas accounts for a 50% share of the anthropogenic greenhouse effect. It is formed during the combustion of solid, liquid, and gaseous fuels (oil, natural gas, coal), deforestation, and soil erosion (oxidation of carbon contained in the soil). It is used in the production of carbonated beverages and mineral waters, in medicine, for fire extinguishing, and as an artificial fertilizer in greenhouses. Solid CO₂, known as "dry ice," is used as a cooling agent in industry.

Carbon monoxide (CO) – (Chem.) – a colorless and odorless gas; burns with a blue flame but does not support combustion. It is utilized in the form of generator gas and water gas. It is frequently the cause of accidental poisoning. At levels of 10 ppm CO in the air, impairment of visual perception and the ability for realistic assessment of events occurs. At levels of 100 ppm, dizziness, headache, and weakness are observed. Loss of consciousness occurs upon exposure to concentrations of 250 ppm, while inhalation of levels at 1000 ppm causes rapid death. Chronic long-term exposure to low levels triggers disturbances in the respiratory system and cardiac activity. Upon entering the body, CO binds with hemoglobin, converting oxyhemoglobin into carboxyhemoglobin. The latter is significantly more stable than oxyhemoglobin, thus its formation prevents hemoglobin from transporting oxygen to the tissues. CO is a potent blood toxin.

E

Ecological conflict – a conflict between science and nature resulting from the psychological imperfection of human beings.

Ecological monitoring – a system for observation, assessment, control, and forecasting of the ecological situation, as well as the prediction of hazards and consequences for ecosystems and the biosphere as a whole.

Ecological object – "an object under the influence of various factors and the environment (biosphere, technosphere, sociosphere). Various species, subspecies, and other groups of representatives of the animal and plant world can be selected as ecological objects (this is primarily the subject of biology and general ecology). Unquestionably, the most important ecological object is the human being, whose study is the focus of medicine, human ecology, medical ecology, and other sciences. Finally, society as a whole or its individual social groups can be selected as an ecological object. These ecological objects are studied by social ecology, which began to emerge in the 1970s and 1980s. Individual social groups can also serve as ecological objects. Their categorization can be based on various criteria: territorial-geographical, national-ethnic, socio-economic, professional, sectoral, etc. A company, an enterprise, or any other subject of economic activity can also be considered an ecological object. The economic entity, regardless of its sectoral affiliation, the scale and nature of its activities, its organizational-legal forms, and other characteristics, can be defined as a specific social group. The existence and development of such a group are possible only under certain conditions—social, political, economic, ecological, etc. To a certain extent, an analogy can be drawn here with any living organism, which can grow and reproduce only within specific parameters of the surrounding natural environment." [150]

Ecological approach – the application of fundamental ecological knowledge as a method across all domains of social practice. The ecological approach serves as the methodological foundation of the educational process, driven by the necessity to reconsider anthropocentrism—manifested in a consumerist societal stance toward nature—and to adopt a new societal paradigm: bio(eco)centrism. This paradigm redefines the interaction between humans and nature. Understood in this way, the ecological approach implies an awareness among adults of the need to create an environmentally sustainable environment and to foster in the child an eco-responsible attitude toward both themselves and their surroundings. This conceptualization of the ecological approach reflects upon the formulation of the goals of educational and instructional activities in schools, as well as the structuring of cognitive content and the technological modernization of pedagogical interaction.

Ecological risk – the probability of alteration and/or destruction (loss) of an ecological object as a result of environmental changes. This definition prioritizes the probable changes in the ecological object, meaning they are primary relative to the changes in the environment. Such a hierarchy holds practical significance: it allows for avoiding the consideration of an infinite number of environmental factors and identifies a limited number of substantially significant factors for a given ecological object. This enables an in-depth quantitative and qualitative assessment of these factors and the management of corresponding risks.

Ecological factor – an element of the environment that exerts a direct influence on living organisms. Ecological factors are classified into: biotic, abiotic, and anthropogenic.

Ecological valence (plasticity or biontivity of the species) – the capacity of organisms to exist within certain fluctuations of a specific factor or a combination of environmental factors.

Ecological literacy – a minimum threshold of knowledge through which one acquires a conceptual understanding of nature and natural balance, as well as the place and role of the human being within the ecosystem.

Environmental ethics – a system of moral norms (standards) that constitute the content of ecological consciousness and reflect a commitment to, and responsibility for, the environment and future generations.

Ecological crisis – the destruction of the ecological environment and the deterioration of the natural conditions essential for human life.

Ecological culture – a system comprised of four components: ecological knowledge, ecological self-awareness, goal-oriented activity (conscious human goals aimed at optimizing interaction with nature), and a unity of attitudes (intellectual, moral, economic, aesthetic, and value-based) toward nature and the environment, manifested in the practical activities of the individual and society. The first component of ecological consciousness (a system of ecological and environmental protection knowledge) is shared with ecological culture. Ecological consciousness serves as a regulatory factor for ecological behavior.

Environmental education (Ecological upbringing) – the value-based formation of the personality, the core of which is morality. Its two dimensions—ecological consciousness and ecological behavior—define the essence of this process. The goal of environmental education is the formation of a responsible attitude toward nature, based on ecological consciousness.

Environmental Education (EE) – "An organized pedagogical process for acquiring ecological knowledge, skills, and habits, which includes: awareness of the interconnectedness and interdependence between organisms and their vital environment; recognition of the mutual links between society and nature and the necessity of establishing harmony between them; a holistic conception of the unity of the objective world; awareness of the need for an optimal environment (both natural and social) for the harmonious and multifaceted development of the individual and their full realization in social practice; and the alignment of every activity and behavior with the fundamental principles of ecology and the requirements of ecological balance.

The content of environmental education encompasses: a system of knowledge regarding ecological objects and processes, methods for their study, and the pathways and means for the interaction between society and nature, including the character of natural resource management; the consequences of societal impact on ecological balance and methods for their optimization; a system of skills, habits, practical rules, and means for studying nature and applying ecological knowledge in direct production practices; experience in creative activity for studying nature and solving environmental problems; and a system of ecological norms, rules, and values and their role in social practice and personality formation.

Education that is directed towards the formation of ecological culture, ecological consciousness, and ecological behavior in their mutual connection and unity, with a view to preserving ecological balance. EE is fundamental to ecologically sustainable development. EE places emphasis on ecological laws, which form the basis of ecological balance and a healthy lifestyle, as well as on the responsibility of the individual and society for their observance. Environmental education that is reduced to only one of the mentioned dimensions of the environment is incomplete and forms a limited vision of our place in the common 'home of life' and our mission on Earth. At the current stage, it continues to enrich its content and areas of application. According to the definition by Z. Kostova, environmental education represents an organized pedagogical process for mastering a system of ecological knowledge, skills, and habits, and comprises the following aspects:"

- awareness of the mutual connection and dependence between living and non-living nature; between organisms and their vital environment
- awareness of the mutual links between society and nature and the necessity of establishing harmony between them
- a holistic conception of the unity of the objective world
- awareness of the need for an optimal environment (natural and social) for the harmonious and multifaceted development of the individual and their full realization in social practice
- alignment of every activity and behavior with the fundamental principles of ecology and the requirements of ecological balance, i.e., with ecology and the scientific basis of each of the mentioned aspects

Environmentally hazardous substances– substances that facilitate or lead to qualitative and quantitative disruptions in ecosystems, as well as changes that impact the viability and adaptation of populations, the growth, behavior, and survival of individual organisms.

Ecological behavior – a system of actions, specific deeds, and purposeful activities involving ecological competencies aimed at the utilization and preservation of nature and human health. It is regulated by ecological consciousness.

Ecological balance – a state of equilibrium between producers and consumers, and between predator and prey.

Ecological consciousness – a form of reflection on the relationship between humans and nature; a complex of views, theories, and emotions that reflect the issues inherent in the relationship between society and the natural world. It is the product of environmental upbringing and education. Ecological consciousness is achieved when ecological knowledge becomes a behavioral norm for the individual.

Environmentally hazardous substances – substances that facilitate or lead to qualitative and quantitative disruptions in ecosystems, as well as changes that impact the viability and adaptation of populations, and the growth, behavior, and survival of individual organisms.

Ecosystem – a holistic part of nature that is not a closed system and can interact with other parts of the environment. It is the fundamental unit in the functioning of living nature. Within an ecosystem, processes related to the transfer and exchange of matter, energy, and information take place. An ecosystem is the totality of populations of different species and the natural environment they inhabit, functioning together through the exchange of energy and substances. It is further defined as the smallest basic functional unit of nature, comprising biotic and abiotic components, or alternatively, as any natural area or volume containing the three abiotic and biotic components.

Characteristic features of ecosystems include: being thermodynamically open; remaining relatively stable in time and space; being independent of external energy sources, with the exception of solar energy; maintaining a continuous cycling of matter and energy exchange necessary for the existence of life. The populations within biocenoses are self-reproducing and capable of self-purification. Every ecosystem is capable of self-regulation, establishing and maintaining a dynamic balance known as homeostasis. The dominant component determines the type of ecosystem—for example, forest, field, mountain, soil, or aquatic ecosystems. It represents any community of living beings and their habitat existing as a unified functional whole. Key attributes of an ecosystem include the cycling of matter and energy flow, the capacity to resist external influences within certain limits, and the ability for self-recovery and development.

The components of an ecosystem are grouped into five consecutive trophic levels (the totality of organisms united by their mode of nutrition): producers (green plants), primary consumers (herbivores), secondary consumers (carnivores and certain parasites), and tertiary consumers (omnivores and other parasites), parasites. Ecosystems are classified into: micro-ecosystems, meso-ecosystems, macro-ecosystems, and the global ecosystem within the boundaries of the entire planet (biosphere). An ecosystem is further regarded as a natural complex of animals, plants, and the factors of their inhabited environment, interconnected through the exchange of matter and energy. An ecosystem is a unified complex of living organisms and the abiotic conditions necessary for their existence. It is the fundamental building block—both spatial and functional—of the biosphere, encompassing the community of living organisms (biocenosis) together with the non-living part of their environment (biotope) and all the diverse interactions

between them. The connection between the biotope and the biocenosis is of a material and spatial nature. The ecosystem is a relatively autonomous unit in which the totality of organisms is energetically linked to the inorganic environment through the biogenic cycling of matter and the flow of energy.

Z

The Law of Limitation and Exhaustibility of Natural Resources: "All natural resources and environmental conditions on Earth are finite."

Environmental pollution – the entry or accumulation in the environment of new, unusual, or uncharacteristic physical, chemical, biological, and informational agents, leading to negative consequences. Environmental pollution can arise both as a result of natural factors and as a consequence of economic human activity.

Pollutant – any agent (chemical, physical, physiological, mechanical, biological, etc.) that, upon entering the environment, exceeds its natural content and exerts an adverse effect on humans, living and non-living nature, and material assets—meaning it can shift the system out of its state of equilibrium.*K*

Cadmium (Cd) – (Chem.) – a chemical element in the secondary subgroup of Group II of the Periodic Table; a silvery-white, ductile, and soft metal used for coating metallic objects, in the preparation of low-melting alloys, in alkaline batteries, and in nuclear reactors. Cadmium compounds are toxic. Cadmium causes acute and chronic intoxication. It adversely affects the functions of certain enzymes, induces painful bone diseases, and damages the kidneys and the gastrointestinal tract. Inhalation of cadmium oxide dust leads to pulmonary edema and lung necrosis. Hypertension, coronary disturbances, and myocardial damage have also been observed. In extremely rare cases, prolonged and intensive exposure may lead to carcinoma of the prostate and lungs.

Carcinogenic– (Med.) – (from Latin *cancer* – crab/cancer and *-genes* – producing) – substance or agent that causes cancer.

Carcinogens (Carcinogenic substances) – chemical compounds or physical agents that promote the development of malignant neoplasms in animals, plants, and humans.

Acid rain – all types of meteorological precipitation—rain, snow, hail, or fog—with a pH lower than the average pH of rainwater (pH = 5.6), resulting from pollution with sulfur dioxide, hydrogen sulfide, and other acidic gases.

L

Lithium (Li) – (Chem.) – a chemical element in the main subgroup of Group I of the Periodic Table; a silvery-white, soft, light metal used in nuclear energy, metallurgy, the glass industry, medicine, and pyrotechnics. Lithium compounds are applied in the manufacturing of special glasses (LiF), in ultrasonic flaw detection (Li₂SO₄), and in medicine (lithium citrate, C₆H₅Li₃O₇). Lithium hydride (LiH) irritates the mucous membranes of the throat and nose, while lithium chloride (LiCl)—used in pyrotechnics to produce dark red flares, in metal welding, for the extraction of metallic lithium, and in the production of dry batteries and photographic reagents—is a toxic compound.

M

Copper (Cu) – (Chem.) – a chemical element in the secondary subgroup of Group I of the Periodic Table; a yellowish-red, ductile, and malleable metal with exceptional electrical and thermal conductivity. It is widely used as an electrical conductor and is a constituent of numerous alloys. In the form of salts, it is utilized for the preparation of mineral pigments, in pest and plant disease control, as micronutrients (micro-fertilizers), catalysts, etc. Copper is a biometal that is part of various biocomplexes such as cytochromes, azurin, plastocyanin, and hemocyanin. Disturbance of copper metabolism in the body leads to liver degeneration and damage to certain brain centers (Wilson's disease). Copper compounds are toxic.

O

Environment – a complex of natural and anthropogenic factors and elements that exist in a state of interdependence and influence ecological balance, quality of life, human health, cultural and historical heritage, and the landscape. Its protection involves activities aimed at preventing environmental degradation, as well as its restoration, preservation, and improvement; it includes the collection of information and monitoring of its state, along with the environmental impact assessment (EIA) of proposed activities.

Lead (Pb) – (Chem.) – a chemical element in the main subgroup of Group IV of the Periodic Table; a bluish-white, heavy, soft metal. It is used for the manufacturing of pipelines, cable sheathing, chemical apparatus and utensils, battery plates, pellets, and projectiles. Lead compounds are highly toxic. Even traces of lead can cause severe diseases (saturnism/lead poisoning) and death. The metal and its compounds cause numerous toxic effects, including the inhibition of hemoglobin synthesis. Lead negatively affects the central and peripheral nervous systems and the kidneys.

Lead poisoning (Saturnism) – intoxication occurring during metallurgical lead extraction processes, or through contact with lead and its compounds in the production of lead-based substances, paints, cables, glazes, glass, pellets, printing types, and alloys. It may also result from using earthenware with lead glazes, lead-containing cosmetics, or lead piping. Acute lead poisoning is rare. Symptoms of chronic lead poisoning include "lead line" (a bluish-gray, nearly black line) on the gums, primarily near the front teeth; "leaden" (yellowish) skin tone; the presence of lead in the urine; reduction of red blood cell count to 3 million and hemoglobin to 50%; severe abdominal colic; inflammation of the oral mucosa; thick saliva; hypertension; bradycardia (40–50 beats per minute); wrist drop and finger paralysis; impairment of hearing and vision; headaches; dizziness; insomnia; epileptic seizures; memory loss; and decreased cognitive and physical performance. The toxic threshold dose is 0.1 mg/m³.

Environmental protection – activities aimed at preventing environmental degradation, as well as its restoration, preservation, and improvement. It encompasses the collection of data and monitoring of environmental conditions, alongside the environmental impact assessment (EIA) of planned activities.

Waste – residues from production or domestic processes in the form of substances, objects, or parts of objects, which the holder intends to or is required to discard due to technological, economic, or hygiene-related reasons.

P

Greenhouse effect – "a process by which radiation passing through a planet's atmosphere warms the Earth's surface to a temperature above what it would be without that atmosphere. It involves an increased temperature of the lower layers of the atmosphere compared to the thermal radiation emitted by the planet." [149]

Surfactants (Surface-active agents) – organic substances with hydrophilic and hydrophobic moieties of distinct chemical structures that reduce the surface tension of water and cause pollution in water bodies. The concentration of these substances in wastewater typically ranges from 5–15 mg/l, while the Maximum Permissible Concentration (MPC) is 0.1 mg/l. These substances can form foam layers in water bodies, particularly at weirs or sluices. Their foaming capacity manifests at concentrations of 1–2 mg/l.

Maximum Permissible Concentration (MPC) – a regulatory standard; the quantity of a harmful substance in the environment which, through constant contact or exposure over a specific period, practically does not affect human health and does not induce adverse effects in future generations.

Natural resource – a component of the natural environment, a natural object, or a natural-anthropogenic object that is used or can be used in economic or other activities as an energy source, a production input, or a consumer item possessing utility value. It is a part of organic or inorganic nature utilized by humans to satisfy their needs. Natural resources are classified as: mineral, agro-climatic, water, soil, biological (plant and animal-based), and recreational. Based on the criterion of substitutability, they are divided into: replaceable (raw materials, fuels) and irreplaceable (water, air). According to usability, they are categorized as: production-oriented (industrial, agricultural), potentially-prospective, and recreational.

R

Risk– (from Fr. *risque*) – 1. A potential hazard. 2. Conscious exposure to potential danger in pursuit of a specific goal and in expectation of an eventual benefit. 3. "The probability of a hazard or crisis materializing under the influence of anthropogenic or natural factors; a potential danger or loss under specific conditions; a multidimensional concept of future loss."

Hazardous substances and materials – substances whose production, transportation, storage, use, or disposal may damage or pose a threat to human health, life, and the environment.

S

Social ecology – a science that studies the temporal and spatial relationships in human life, the impact of selective adaptive forces of the environment, and the reciprocal influence of the structure of the natural environment. A social science concerned with the relationship between societal development and the environment, as well as the problems arising from this interaction. It examines alternatives for rational human activity within the biospheric ecosystem. The subject of social ecology is the fundamental laws of interaction between society and nature.

F

Fauna – (from Lat. *fauna*) – the collective assemblage of all animals within a specific region, country, or era (named after the ancient Roman goddess of forests and fields); the component of nature encompassing the animal world.

Physical pollution – environmental pollution manifested as deviations from normal thermal-energetic, wave, radiation, and other physical properties.

Flora – (from Lat. *flora*) – the plant world; the collective assemblage of all plants in a given country or era; vegetation (named after the Roman goddess of the plant world); the component of nature encompassing the plant world.

Ch (H)

Chemical pollution – an alteration of the natural chemical properties of the environment exceeding permissible standards, or the introduction of substances into the environment that are normally absent. These typically include industrial byproducts, agricultural and domestic waste, automobile exhaust gases, and products of oxidation-reduction processes in industry and households.

Table 1. Knowledge, skills, and competencies resulting from the "Technologies and Entrepreneurship" education, and additional knowledge related to the ecologization of the curriculum.

<p>Skills, knowledge, and attitudes resulting from the student's education in the subject "Technologies and Entrepreneurship" at the primary school level (Key Stage 1 & 2).</p>	<p>Additional skills, knowledge, and attitudes resulting from the ecologization of the curriculum in the subject "Technologies and Entrepreneurship"</p>
<p>Within the 'Technology and Safety' competency area, the skills for supporting sustainable development, a healthy lifestyle, and sports are situated in the context of the knowledge, skills, and attitudes acquired in the core area:</p> <p>The student is familiar with the purpose of common household appliances and their safe and environmentally responsible use</p>	<p>Correlates noise levels and sources with their effects on human health.</p> <p>Identifies the primary sources of water, soil, and air pollution.</p>
<p>At the lower secondary level of education, the specific learning objectives of the subject 'Technologies and Entrepreneurship' include</p>	<p>Within the framework of basic education, specifically at the lower secondary stage, the specific learning objectives of the</p>

	subject 'Technologies and Entrepreneurship' involve...
<p>Within the 'Initiative and Entrepreneurship' competency area, the competencies for supporting sustainable development, a healthy lifestyle, and sports are situated in the context of the skills, knowledge, and attitudes acquired in the core areas</p> <p>The student demonstrates resourcefulness, activity, and imagination in tasks related to various topics and projects.</p> <p>The student correlates the production of goods and services with the satisfaction of personal and public interests."</p>	<p>Differentiates between various sources of water, soil, and air pollution. Formulates practical measures to improve air, water, and soil quality and develops projects for their conservation. Discusses potential changes in daily behavior aimed at reducing water, air, and soil pollution. Investigates the impact of environmental pollution on individual health. Establishes rules for responsible waste-related behavior within the classroom, school, family, and in public and natural spaces (parks, streets, mountains, and the sea). Formulates plans and participates in collaborative nature conservation activities. Acquires information regarding biofuels. Is familiar with the Law of Inexhaustibility of Natural Resources.</p>
<p>In the field of competency "Construction and Modeling", skills supporting sustainable development and a healthy lifestyle and sports are within the context of knowledge, skills, and attitudes acquired in the core curriculum [1.2]. Students learn to evaluate their own work and the work of others according to given criteria [1.2].</p>	<p>Describes the main components of atmospheric air and the water cycle, and discusses the significance and importance of water, the atmosphere, and soil according to their functions in nature and their role for living organisms and humans. Provides arguments for the necessity of protecting the purity of air, water, and soil, and the contribution of each individual. Is familiar with the "Polluter Pays" principle.</p>
<p>In the field of competency "Construction and Modeling", skills supporting sustainable development and a healthy lifestyle and sports are within the context of knowledge, skills, and attitudes acquired in the core curriculum [1.2]. Students learn to evaluate their own work and the work of others according to given criteria [1.2].</p>	<p>Describes the main components of atmospheric air and the water cycle, and discusses the significance and importance of water, the atmosphere, and soil according to their functions in nature and their role for living organisms and humans. Provides arguments for the necessity of protecting the purity of air, water, and soil, and the contribution of each individual. Is familiar with the "Polluter Pays" principle.</p>

<p>Within the 'Household and Industrial Technology' competency area, the knowledge for supporting sustainable development, a healthy lifestyle, and sports is situated in the context of the knowledge, skills, and attitudes acquired in the core areas:</p> <ul style="list-style-type: none"> • The student is familiar with the methods for the transmission, storage, and transformation of energy. • The student operates machines and tools in accordance with operational requirements. • The student adheres to the rules for safe operation and energy efficiency regarding the technology used. • The student demonstrates skills for maintaining hygiene in both domestic and work environments." 	<p>Identifies diverse energy sources and production methods and explains their impact on the atmosphere and the environment. Evaluates the importance of energy conservation for preserving natural resources and formulates behavioral rules for the home, classroom, and school. Discusses the efficient use of resources and the maintenance of cleanliness in both natural and urbanized areas. Is familiar with noise pollution and its effects on human health. Acquires knowledge about the anthropogenic electromagnetic field generated by household appliances and electronic devices, and its harmful effects on health. Is familiar with the principles of housing ecology.</p>
<p>Within the competency area 'Processing, Assembly, and Combination of Materials, Products, and Modules', the skills for supporting sustainable development and a healthy lifestyle are situated in the context of the knowledge, skills, and attitudes acquired in the core area:</p> <ul style="list-style-type: none"> • The student applies fundamental technological operations in the processing of materials and products." 	<p>Defines the term "waste," describes, and categorizes various types of municipal waste according to their composition – organic, plastic, paper, cardboard, glass, metal, wood, leather, rubber, and textiles. Investigates the impact of environmental pollution on human health. Structures rules for responsible waste-related behavior within the classroom, school, family, and in public and natural spaces (streets, parks, mountains, and the sea). Outlines the material cycle and provides explanations for different methods of waste processing and recycling. Identifies the core principles of treating different types of waste, such as landfilling, recycling, composting, and incineration. Demonstrates waste segregation as a fundamental approach to waste management.</p>

<p>Within the 'Organization and Economics' competency area, the skills for supporting sustainable development, a healthy lifestyle, and sports are situated in the context of the knowledge, skills, and attitudes acquired in the core area:</p> <ul style="list-style-type: none"> • The student plans and implements a project based on specified criteria." 	<p>Formulates plans and participates in collaborative activities for nature conservation. Discusses potential changes in daily behavior aimed at reducing water, air, and soil pollution. Participates in public campaigns related to environmental issues and evaluates their role and significance for the community. Is familiar with various information sources related to environmental protection. Distinguishes between the roles of governmental institutions and non-governmental organizations (NGOs) involved in environmental protection. Discusses options for individual contribution and lifestyle choices towards nature conservation. Works in a team to discuss ideas and participates in activities related to changing consumer behavior aimed at reducing greenhouse gas emissions into the atmosphere.</p>
<p>Within the 'Agro- and Zootechnologies' competency area, the skills for supporting sustainable development, a healthy lifestyle, and sports are situated in the context of the knowledge, skills, and attitudes acquired in the core areas:</p> <ul style="list-style-type: none"> • The student utilizes various information sources for career and profession selection. • The student is familiar with different methods for cultivating fruits, vegetables, ornamental plants, and herbs. • The student describes technologies for raising animals both at home and on the farm. • The student understands the benefits of ecological standards in plant cultivation and animal husbandry. • The student is familiar with the requirements for healthy nutrition. 	<p>Demonstrates solidarity and cooperation with various social entities to achieve common environmental goals. Discusses the advantages of organic farming over conventional agriculture. Explains the concept of sustainable development and its priorities. Describes and classifies the types of biosphere pollution and evaluates their impact on human health. Identifies food contaminants and outlines rules for reducing their harmful effects on human health. Is familiar with the effects of xenobiotics – such as food additives, artificial fertilizers, and pesticides – that enter the human body through the food chain. Is familiar with methods for reducing the volume of agricultural waste.</p>

--	--

CONCLUSION

The formation of ecological culture is not a fleeting phenomenon but a logically substantiated pedagogical imperative concerning the unconditional requirement to maintain the balance in nature. This balance is crucial for the preservation of the individual's physical and spiritual health. Alongside legislative measures, it is necessary to enhance the ecological culture of all citizens, with this enhancement focused particularly on children, because environmental impact awareness and education are essential for survival.

In this regard, ecology holds a life-sustaining significance for humanity. The methods by which society impacts nature are creating progressively global ecological crises, the management of which requires complex environmental competence. No activity exists that does not, directly or indirectly, concern the ecological balance and the living environment of people; thus, ecology is a necessity for everyone.

Scientists warn that if the trend of progressive environmental pollution and the critical depletion of certain raw materials is not reversed, the existence of humans as a biological species will be threatened. Therefore, it is imperative that all activities, and especially industrial and production activities, are placed on ecological foundations. This will enable people to preserve what remains of their living environment and to reinforce their drive towards actions aimed at its restoration.

The environmental threat is self-evident, and ecological problems demand immediate resolution through the collective involvement of all scientific disciplines and all spheres of human activity; therefore, the requirement for universal ecological literacy is both timely and socially significant.

The framework of a society's cultural identity in any historical period is established by the education it provides. The entire arsenal of an individual's knowledge, skills, motives, and value orientations dictates the character and nature of their actions, as well as their overall behavior.

The ecologization of the curriculum serves as a definitive guarantee for the formation of an ecological culture. Instilling the necessary values, attitudes, and predispositions in the younger generation toward nature and its abundance is a fundamental prerequisite for sustainable development.

PUBLICATIONS:

1. Todorova, I. B. (2022). An innovative method for attention of children by using machines for 3D printing and its environmental aspect in Bulgaria. In *International Scientific and Practical Conference "Social and Pedagogical Innovations in Education"* on Program "Ijevan

Valley EdTech”, March 15–16, 2022. Yerevan State University Publishing House. pp. 413–415. ISSN 978-9939-1-1442-2.

2. Slavova, I. B. (2023). Competencies in the field of innovations and entrepreneurship. *Annual of Shumen University "Episkop Konstantin Preslavski", Faculty of Pedagogy*. Shumen: University Press "Episkop Konstantin Preslavski". pp. 351–355. ISSN 1314-6769.

3. Slavova, I. B. (2023). Interactive technologies stimulating the interests of children from upper and lower secondary stages towards education and the discipline "Technologies and Entrepreneurship". *Annual of Shumen University "Episkop Konstantin Preslavski", Faculty of Pedagogy*. Shumen: University Press "Episkop Konstantin Preslavski". pp. 356–359. ISSN 1314-6769.