



Article

Nature Ideas Exchange: Education of Sustainable Business Principles Based on Parallels with Forest Ecosystem

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Abstract: Arne Næss considered nature the best source of knowledge and regarded the economists as morally responsible for the ecological crisis. Therefore, this research focused on students of economic fields at the university level. The experimental group ($n = 236$) led by a teacher-as-researcher completed a Business Economic course by forest workshops for one semester because the sustainability principles can be very well explained and observed on examples of forest fauna and flora and then applied in managerial practice. Many similarities were found between forest and business principles (optimal growth rate, teamwork, cooperation models, parasitism). This paper aimed to identify if students' proficiency in applying sustainable mindset from a forest ecosystem to practice increased. The achievement test compared outcomes of the experimental and control group ($n = 190$) of students. Based on statistical testing, it can be stated that the experimental intervention led to better results compared to the control group. For issues in which no suitable parallel with the forest ecosystem was found and were therefore explained according to the textbook, group (E) did not perform better than group (C). The methodology is based on qualitative and quantitative research, a mixed-methods approach.

Keywords: deep ecology; Arne Næss; value objectivism; forest educator; forest fauna and flora; cooperative models; forest pedagogy; business principles



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1. Introduction

The world is going through an ecological crisis, the symptoms of which include climate change, air pollution, the problem of waste and landfills, biodiversity loss, water pollution, deforestation, unsustainable land use and habitat loss [1–3]. These points are merely a selection of the most striking manifestations. The idea of human supremacy seems self-destructive [4,5]. Henry David Thoreau (1817–1862), Ralph Waldo Emerson (1803–1882) and Aldo Leopold (1887–1949) were the most prominent thinkers. They believed that environmental problems arose due to ideas and attitudes towards nature and excessive consumption [6–8].

1.1. Deep and Shallow Ecology

The Norwegian philosopher Arne Næss (1912–2009) considered the ecological crisis due to human attitudes of superiority over nature and aimed to create a new harmonious relationship between humans and nature. Næss described his philosophy as Deep Ecology, based on Value Objectivism [9–11]. This philosophical approach does not consider human beings to have more excellent value than other forms of life. The idea of the supremacy of the human species (supremacy is based on the taxonomic rank of *Homo Sapiens*, which is valid over all geopolitical influences [12,13]) should be abandoned. Animals have value in

themselves with the right to live, even though they are not beneficial to humans. Due to this approach, humans cannot be separated from the environment [9,14], and if they harm nature, they endanger themselves [15,16]. All living and non-living organisms (people, animals, plants, water, rocks, mountains) are interconnected and cannot be isolated or considered separately. Næss called his concept of ecology the adjective “deep” because, according to the author, he asked deep questions and, in many ways, criticised the so-called “shallow” approach. According to Deep Ecology, the causes of ecological crises can be solved by a transformation in human thinking accompanied by a reduction in demands [17].

Næss considered Shallow Ecology to remedy human behaviour’s consequences (for example, reducing the atmosphere and slowing down natural resources extraction) and does not fight the environmental crisis’s causes. Næss described the Shallow Ecology approach as cosmetic because the economics position is always preferred here [18]. In addition, the natural capitalism concept can be included in the Shallow Ecology [19–21].

1.2. The Link between Deep Ecology, Education for Sustainable Development and Forest Pedagogy

It is not relevant to expect a positive and active approach from people who were not in proper contact with nature during their growing up [22]. Forests and wild nature disappear from the personal experience of children [23,24]. The world full of information and communication technologies is a physically contactless world between people and nature [25,26]. Environmental issues will affect the generations coming after us; they will carry the legacy we leave. Therefore, the environmental problem is also a problem of education and parenting [27]. It is necessary to apply a philosophical element to education, which emphasises the absolute priority of life and introduces a biophilic value orientation into human thinking, which is the task of ecological philosophy [1,2].

There is no one and 100% “most appropriate” pedagogy for sustainable education, but there is a consensus on active, participatory, engaging and experiential learning methods. Is it education for sustainable development if we place individuals in a lecture hall and give them a continuous tutorial on economic growth, resource management, poverty and externalities in an economic, environmental and social context? Yes and no: they gain an overview from an interdisciplinary perspective, but due to the chosen (frontal) teaching method, knowledge acquired in this way may be shallow, interdisciplinary links do not develop sufficiently and attention would be declining [28]. Frontal teaching does not develop learning competence [29].

Næss recommended getting feelings and emotions into the learning process because there is no life of pure knowledge and a life of feelings as something separate. How we relate to nature is a matter of feeling [30,31], and those feelings have cognitive value. The essential tool is the non-rational form of cognition, empathy, identification through emotions, not through reason. If children succeed in raising emotional relationship with nature and Earth, there is a chance that they will behave ecologically in the future [14,15,32]. According to A. Næss, education should consist of events, experiences and creative activities [33].

Neoteric educational discipline, which corresponds to Deep Ecology’s philosophy for affecting emotions, will and awareness, is forest pedagogy as forest-related environmental education [34] addressing social, environmental and economic dimensions of sustainability [35]. Forest pedagogy is based on the experiential method, which uses the senses, i.e., experiences and feelings. Cornell [36–38], who is considered the founder of forest pedagogy, describes four experience levels: awakening enthusiasm, focusing attention, direct experience and sharing inspiration. According to Pestalozzi’s concept of learning with head, heart and hand, forest pedagogy’s basic principle is the perception of nature by all senses [39]. Understanding ethical values come through the perception of situations, nature and other people. The central premise of forest pedagogy is that what the individual understands, what he/she is connected to in terms of value, he/she is then willing to protect and support in the future. Forest pedagogy develops emotional intelligence; supports cooperation and teamwork, self-awareness and co-responsibility. Education is carried out in groups; the

individual is part of this group and is thus constantly exposed to many social stimuli. The goals of forest pedagogy include getting closer to nature, introducing human's cultural activity in the forest and realising the forest's economic and existential importance. Forest pedagogy is based on Changemaking, Learning in Life, Crossover Learning, Incidental Learning, Context-based Learning, Learning by Doing Science, Gamification [40] and deals with the interview, brainstorming, brainwriting, discussion, demonstration, practical activities, thematic games, competitions, simulation, situational methods and dramatisation [35]. These methods transfer learning to its original roots: to discover, to feel, to taste, to connect, to play, to dare to something, which was also emphasised by Næss [14,33].

The link between Deep Ecology, education for sustainable development and forest pedagogy lies in conjoint encouraging people of all ages at all stages, taking place within various possible learning spaces (formal or informal), using creative activities. The joint effort aims to understand the broad context of environmental, economic, social and political aspects, reflecting on personal experiences while using creative activities [14,18,19,28,34].

1.3. Study Design Based on Forest Ecosystem

It is generally known from pedagogy that an environment that addresses multiple senses at once is considered stimulating. For this reason, the forest environment was chosen. This reasoning is supported by the outputs of several impacted scientific studies, including Stanford Analysis [41], Agirreazkuenaga [42], Enberg and Harlap [43]; Thomas, Munge [44], Karpinen [45], where authors conclude that the natural environment develops potential, children acquire tacit knowledge, the necessary depth of information and know-how. These studies have clearly shown that outdoor environmental and sustainability education has led to many positive impacts, such as improving academic performance, enhancing critical thinking skills, developing personal growth and life-building competencies, including self-esteem, increased civic engagement and positive environmental behaviour. Pan and Hsu [46] assessed the effects that only a one-day environmental educational program at nature improved environmental literacy with a lasting effect.

Decades of research into human behaviour have generally recognised that programs focusing primarily on providing new information do not influence behavioural outcomes, and the environment plays an important role [47–49]. It is consistent with Næss's recommendations on the involvement of emotions and activities in learning and teaching [14,32,34] and Pruneau's [50] on teachers, scientists and students' collaborative teamwork. Teamwork and the ability to work effectively with others are considered essential for academic success and employability by Cooley, Burns and Cumming [51]. Shooter, Sibthorp and Gookin [52] found a positive relationship between trust in outdoor leaders and the course outcomes.

The intelligence of all phenomena and activities in nature has been inspiring for man. Biomimetics solves living organisms' research, their structural solutions and applying the knowledge gained in this way, especially in modern technologies [53]. The holistic thinking and understanding of complex sustainability systems can also be well demonstrated in parallels with nature's living ecosystems. Rösler [54] introduces the term "Nature Ideas Exchange": nature offers many analogies applicable to management practice, on which the principles of sustainability can be presented uniquely. Pavlík and Kopčaj [55–57] raise processes and interactions in society and consider them very similar to nature proceedings and interactions. Every day, adaptation and optimisation processes, crisis management, competition, cooperation and innovation occur in nature. Millions of animal and plant species compete in nature for resources as well as enterprises do. The constant pressure on assimilation and competition has led to comprehensive resource management, high-level specialisations and sophisticated survival strategies and collaborative models [58]. The forest has been a natural framework for human existence for many centuries. The forest, as the most natural place in the middle of a densely populated cultural landscape, is becoming increasingly important as a living and experiential space. The forest is a complex ecosystem and researchers have focused on its educational function.

1.4. Students of Economic Fields as Suitable Target Group

Arne Næss considered economics to significantly impact the environment because of natural resources exploitation [59]. Næss considered economists morally responsible for such a situation with their short-sighted and selfish actions; they resigned to wisdom and advised people in power how to achieve economic goals [14]. Therefore, researchers tried to encourage students of economic fields to learn how to think sustainably and widen the scope for more ecological and social aspects. The researchers' intention was for future economists to abandon their ideas about the human species' supremacy and be forced to think about the ecosystem's sustainability as they become managers, politicians and entrepreneurs with a share in decision-making in the future. Through forest workshops, future economists were given the opportunity to understand the principles of sustainability. Researchers tried to modify Arne Næss philosophical concept to have a transformative effect. The present generation of university students of economic fields could be considered as change agents in rethinking sustainability. According to Tilbury and Wortman [60], the themes relevant to ecological and sustainability education should be taught at universities of economics: including natural resource management, sustainable consumerism, poverty reduction, the waste reduction from production processes, learning organisations, change management, corporate social responsibility, globalisation, balanced growth, economic viability and fair-minded society.

2. Materials and Methods

This research aimed to identify whether the tuition of sustainability in the form of analogy with the forest ecosystem using forest pedagogy methods [35–38] will improve university students' understanding and thinking in the context of sustainable (and forest) development. The workshops were intentionally conducted in a forest environment, as the forest is a living demonstration of sustainability principles for millions of years. Students can easily observe, understand and then apply these principles in future management practice.

Due to the previous studies and the issue's scope, the following hypothesis was determined. H: Experimental intervention in the form of forest workshops in the experimental group will lead to better results in the achievement test than in the control group. A mixed-methods approach within quantitative and qualitative methodology was chosen (analogy, focus groups, statistical testing).

2.1. Didactic Experiment

The research was designed, conducted and implemented by one of the researchers as a teacher-as-researcher to prove innovative teaching methods and enhance the classroom culture. The teacher-as-researcher is also the primary instrument for data collection and analysis.

New forms of activity were organised on a limited scale (in several groups, at a University in Prague with an economic focus) to investigate scientifically new sustainability education forms compared with traditional methods (frontal tuition). This teacher-as-researcher works as an assistant professor at two universities with an economic focus and teaches the Business Economics course at both of them; the content, learning objectives and competencies of which are given accreditation, and both cases are practically identical. The difference was in the teaching method. Universities with an economic focus were selected for this research based on the conviction of A. Næss, who considered the economy and economists morally responsible for the ecological crisis. According to Næss, economists resigned to wisdom and advised people in power by what means to achieve economic goals [14].

One school's management agreed with the experiment (it will be referred to as University A); another university's management rejected the experiment and called it ineffective and unnecessary (it will be referred to as University B). All students ($n = 236$) of the first University A thus became part of the Experimental Group (E), students of the second University B ($n = 190$), whose management disagreed with the experiment, formed a

control group (C). There were students with different learning prerequisites in both groups, learning speeds, and motivation to study.

The 3rd year University students aged 22–23 years studying the subject of Business Economics at University A were involved in the experiment. This subject tuition was carried out for one semester in September 2019–December 2019 (4 months, which corresponds to 15 weeks, once a week, consistently for 90 min) in regular outdoor forest workshops “Searching for parallels between the forest ecosystem and economy”. A total of 236 full-time students participated in the pedagogical experiment ($n = 236$). The maximum group size was 24 people.

2.2. Comparative Research

The experimental (E) group included 236 students ($n = 236$) and there were 190 students ($n = 190$) in the control (C) group. Both groups (E) and (C) were taught Business Economics course with the same content, the same teacher (teacher-as-researcher), but the learning methods differed. The control (C) group was taught in a standard frontal way, without the fieldwork. Teacher-as-researcher worked with the experimental (E) group differently. First, the teacher-as-researcher, accompanied by a forest educator, explained how the individual plants and animals behave and their mutual ties and specifics. The teacher-as-researcher and forest educator used demonstration methods showing strategic partnerships, competition, cooperation, logistics, stock management, adaptation and innovation on the examples of living trees, bees, squirrels, gastropods, ants, cones, mushrooms and plants. Students worked in four people’s teams, searching for parallels between the sustainability of the forest ecosystem, business and economy through observation, discussion, brainstorming, mind maps, educational games and experiences [35–38].

2.2.1. Achievement Test

An achievement test was used to verify the experiment’s outcomes, comparing two groups: experimental (E) and control (C). An achievement test is a tool for systematic measurement of teaching results; it is an exam that focuses on the objective determination of the curriculum’s mastery level in a particular group of people [61]. The achievement test involved the content which students of both groups (C, E) were expected to learn (according to valid accreditation) and was constructed on the basis of the learning objectives of the Business Economics course. Table 1 provides classification of questions according to the thematic focus. Learning objectives were incorporated into questions and tasks, which are listed in Table 2. The achievement test was designed, verified, evaluated and interpreted according to predetermined rules; for example, solving one problem must not influence other problems. Likewise, the correct answer in one task must not depend on the correct answers in another task. The teacher-as-researcher assigned a student number of points for his/her solution depending on how the student used the solution to exhaust the question’s topic. To pass the exam, the student had to write a test for at least 60% success. Emphasis was placed on the application of knowledge over mere memorisation. The tasks were open, structured, wide-ranging and objectively scoreable. The tasks verified what was most important in the given curriculum.

The content of the Business Economics course is given by accreditation file and for both Universities, A, B, is almost identical: represents the concepts of business principles; the establishment and termination of the company; resource management; growth rate; organisational structure of the company; change management; property and capital of the company; cooperation models; investment activities; inventory and stock management; human resource and diversity management; rudiments of marketing. The achievement test’s construction was based on several authors’ recommendations in the economic field [62–65]. Items were framed as open questions and were approved by the heads of economics departments of both A and B Universities to remove uncertainty and ambiguous concepts.

Table 1. Classification of questions according to the thematic focus.

Topic	Questions Concerning the Topic
Sustainability	1, 9, 11, 12, 18
Company and business practices	2, 5, 10, 14, 15, 16, 17, 19, 20, 21
Financial issues	3, 8, 13
Resources	4, 6, 7
Total	21

Source: The author's processing.

2.2.2. Statistical Evaluation

The evaluation of the results differed due to the number of points allotted to individual questions. Twenty was the maximum number of points that could be obtained for each question, with the minimum being four points. In the evaluation in the results section, the given range of possible points is then awarded for each question. The nature of the evaluation corresponded to the ordinal scale, although some literature states that, for example, a 9-point and higher evaluation can already be considered an interval scale. Such an approach has long been known within the field of sensory evaluation, where the practice of 9-point evaluation is commonly known and widely used [66,67]. The increasing range of the scoring scale (in our case, up to a 20-point scale) should then, when accepting this view, mean an even greater approximation to the interval scale. However, preliminary testing of the data set to find possible parametric distribution in the data showed that even the results obtained on the 20-point scale did not have parametric distribution for the control group using the Kolmogorov-Smirnov test (statistic = 0.14; $p < 0.01$), and the Shapiro-Wilk test (statistic = 0.92; $p < 0.01$), and for the experimental group using the Kolmogorov-Smirnov test (statistic = 0.15; $p < 0.01$), and the Shapiro-Wilk test (statistic = 0.94; $p < 0.01$). The Kolmogorov-Smirnov test makes it possible to test whether two one-dimensional random variables come from the same probability distribution or whether the one-dimensional random variable has an assumed (theoretical) distribution [68]. The Shapiro-Wilk test of data normality determines whether data distribution can be considered parametric [69].

Such an approach is also justified because statistical research has long used 9-point ordinal scales [70]. For the above reasons, all values obtained are considered with the non-parametric distribution. The Mann-Whitney U test was used to test statistically significant differences between the control and experimental groups [71].

The number of subjects in the control group was 190; the number of subjects in the experimental group was 236. If the participants refused to answer the question, this answer was counted as a missing value (is not substituted by zero). Given the inclusion of an ordinal scale, the descriptive statistics presented should include a mode or median presentation [72], but this is more typical of the conversion of nominal categories (words) to the ordinal scale [73] when it is difficult to interpret the result as “good-and-half”. However, in this case, points having a quantitative nature were calculated for individual subjects' questions from the beginning. Due to this dual nature of the data, we presented the median with lower and upper quartile and the mean \pm standard deviation in the descriptive statistics. The results then show that the interpretation of trends based on both groups of values was the same.

2.3. Focus Groups

To find out the attitudes of the workshop participants, an interview with a focus group was chosen. This form of group questioning was organised in order to obtain the most valuable data from respondents through their mutual interaction [74]. The experimental group of 236 students was divided into subgroups of twelve participants for twenty groups. The teacher-as-researcher moderated discussion with twelve participants to interact between them. This interaction process uses group dynamics [75]. The group

members were acquainted with the rules (all interviews take place in the forum, all present members can participate in the discussion, everyone has the right to express their opinion, everyone has the right to refuse an answer). There was an effort for only one participant to speak in the group at a time, i.e., so that participants could take turns in expressing their opinions. For critical statements, transcription was performed (including substandard expressions), followed by an analysis of the obtained data, coding of the same thematic units and subsequent integration of the units to a higher level up to the final synthesis.

The students of the experimental group were asked the following questions:

1. Which parallel impressed you the most and why?
2. Which behaviour of forest animals/plants do you find most analogous to the company?
3. Which behaviour of forest animals/plants comes to you most effective and with what?
4. What do you think that balance is guaranteed in nature? In the forest, have you found anything (any element) that induces a state of balance?
5. What type of forest fauna/flora behaviour do you find most applicable in the company's teamwork?
6. What type of forest fauna/flora behaviour do you find most useful, inspirational in the production process?
7. Let us look at the beehive. Is it fair that the trumpet will remain the trumpet and the bee-worker a bee-worker? What if the trumpet wanted to become queen? Would it be appropriate to disrupt it?
8. What holds a moving swarm (bees) or flock (fish, birds) together?
9. Why do you think the scales on a pinecone (pineapple, artichoke) are arranged in precisely one particular way?

The Focus Group aimed to discover the attitudes to the given questions and the most critical aspects influencing answers. The moderator (researcher) encouraged the students to explain their points of view.

3. Results

This section presents the results of enterprise-forest observations and the outcomes of analogy between them. They are followed by evaluation (descriptive statistics) of achievement test of the experimental and control group and selected statements of focus group participants.

3.1. Parallels between Forest Ecosystem and Economics Based on the Analogy of Forest Fauna and Flora and Enterprise

The following text represents the forest educators and teacher-as-researcher explanation of the topic. Résumé means analogy detected by students.

Man and tree: structure of wood and tree trunk, morphological characteristics. Résumé: blood-sap, hands-branches, age 80 years.

Forest ecosystem and school ecosystem: plant nursery to grow forest tree seedlings for forest regeneration. Résumé: cultivation of young people (like trees), biodiversity in the forest and the classroom, adaptation, survival strategies at school, cooperation, dynamics.

Bee and plant (*Apis mellifera*): the bee is saturated with pollen and guarantees the flower its reproduction. Résumé: mutually beneficial and altruistic cooperation.

Squirrels (*Sciurus vulgaris*): sorting winter stocks, the "Chunging" memory strategy. Résumé: inventory and stock management theory and logistics.

Mushrooms (*Fungi*): fungi as decomposers, parasites or mutualists living in symbiosis with vascular plants or algae. Résumé: symbiosis represents models of cooperation (holding, cluster, cartel, merger), family businesses (symbiosis, and transfer of know-how between generations). Mutualism in economics is based on the Labor Theory of Value [76]. Parasitism has apparent parallels with business-like reputation parasitism, fraudulent practices, tunnelling, exploitation of employees, sponging, corruption, nepotism and manipulation.

Ants (*Lasius niger*): the way ants use scent marks—pheromones—to find the shortest path between a food source and an anthill. Résumé: logistic and optimisation problems, critical path method.

Bees in the beehive (*Apis mellifera*): The communication of bees in many ways; division of labour between different castes, some care for protection and safety, others care for larvae, others forage; hierarchy, bee dances in search of a place for a new hive. Résumé: organisational structures of the company, precise definition of powers and competencies, each individual has a role and place; the search for new places to collect pollen means the search for new markets, participatory economy, the principle of parent and subsidiary company, precise communication.

Ants (*Lasius niger*), termites (*Isoptera*) and aphids (*Aphidoidea*): ants supply the fungi with plant tissue and then these fungi become the primary source of their food. Aphids contribute their organic matter, and ants protect them. Résumé: if we want to get something, we have to give something ourselves, the exchange principle.

Swarm intelligence: A flock of animals behaves and moves like one living organism with a certain logic without anyone commanding them; they act uniformly. Résumé: synergistic effect, logistics, teamwork, diversity management.

Pinecone (*pinus*), Fir cone (*Abies alba*), Spruce cone (*Picea abies*), Sunflower (*Helianthus*), Cactus (*Obregonia denegrii*), Artichoke (*Cynara scolymus*), Pineapple (*Ananas comosus*): The *Sectio aurea* and the Fibonacci sequence [77]. Résumé: the number of spirals is not random; it is always by the number corresponding to the Fibonacci sequence's adjacent numbers.

Twigs of blackberries, apples and lindens: Phylogenesis. Résumé: efficient use of space and ergonomics.

Macrogastra plicatula: A shell has the shape of a logarithmic spiral [78], and by approximating the logarithmic spiral in the golden triangle, three triangles DEF, AED, ABC are created. According to Kopčaj [68], the vertices of these three triangles mean in business practice routine activities and processes (1), changes, innovations and adaptations (2) visions, missions and strategies (3). Résumé: the development of the company should trace a logarithmic spiral similar to a snail shell. The firm's optimal and long-term sustainable development can be achieved if all three areas develop equally, following the *Sectio aurea* rules. If the business reaches the optimal ratio, it will start development, as confirmed by Rotschedl [79].

Wild boars (*Sus scrofa*): prosocial behaviour inside the pack, omnivores. Résumé: energy invested in cohesion creates communities that are exceptionally resilient to external threats, undemanding consumer behaviour, enormous adaptation ability.

Wolves (*Canis lupus*) and ravens (*Corvus frugilegus*): Ravens like to live with packs of wolves, where wolf cubs already play with blackbirds. When an enemy appears, ravens warn wolves. Wolves reward ravens by sharing their prey with them. Résumé: there is nothing wrong with the seemingly disparate relations between genuine partnerships based on cooperation and tolerance.

The evolutionary theory of Ch. Darwin: Change. Résumé: change management. The market competition discards those who are unable to adapt to market requirements.

The Most Common Observations of Enterprise-Forest Dimension

Bee and flower: with its scent and beauty, a flower attracts a bee, just as a company advertises and attracts new clients.

Bee in the beehive: every bee knows where its place is and what its function is. There is an interplay of activities like in a car factory.

Wild boar: adaptation to new markets (new food sources), courage to look for a new market (wild boar is not afraid to look for food in a populated settlement).

Wolf and raven: finding a relationship between disparate activities, if I cannot defeat the predator (wolf), I will connect with him, offer him a counter-service; inhomogeneous sources are intertwined in production processes.

Swarm intelligence: they have found an activity for which they have an innate disposition, cohesion, pull together. Similarly, it can work in institutions where employees are about as intelligent (teachers, doctors in a hospital), in the military = or in the navy—where, thanks to training, drill, they behave as a whole.

Pinecone: production of clothing, fabrics and fibres of various materials (window films, breathable materials for sports purposes)

Snail shell (*Macrogastra plicatula*): grows smoothly, oscillates with the centre in a particular proportion, growth is smooth, gradual, in a specific ratio the shape of the shell; balanced proportional growth in length and width. Similarly, the company should copy this optimal line of growth.

Table 2 presents another part of the results. Students of both groups wrote the identical achievement test, containing 21 questions and numerical examples. The questions had a different range of points according to their difficulty. The only difference was that group (E) had part of the tuition through forest workshops, while group (C) had exclusively frontal classes. Table 2 contains the median, standard deviation, z-value and p-value of groups (C) and (E) for all questions thematically focused on sustainability, company and business practices, financial issues and resources. In parentheses below the question, it is stated, which parallels with the forest ecosystem were demonstrated, or whether the topic was explained according to the textbook (when the teacher-as-researcher did not find a suitable parallel company-forest). Examples from forest fauna were intentionally described intelligibly to encourage urban students from the capital into the discussion.

Higher values equal a better result. The following questions turned out statistically significant better for the experimental group ($p < 0.01$): questions 1, 4–12 and 14–21. z-values show that the most significant differences between experimental (E) and control (C) groups were found in questions focused on new market search (z-value = 13.78); cooperation models (z-value = 12.36); communication and teamwork (z-value = 12.29); illegal and fraudulent practices (z-value = 12.25); logarithmic spiral and optimal growth rate (z-value = 12.23); horizontal and vertical cooperation and human resource and diversity management (z-value = 11.86); consumer behaviour (z-value = 11.75); organizational structure of the company (z-value = 11.48); inventory and stock management (z-value = 9.94); critical path method (z-value = 7.68); adaptation and change management (z-value = 6.92); resource management (z-value = 6.69); Fibonacci sequence (z-value = 6.35); labor theory of value (z-value = 5.40); synergistic effect (z-value = 5.17); investment activity (z-value = 4.08).

The search for new markets was demonstrated in the example of bee dances, to which a bee passes on specific information about new food sources to other bees. Cooperation models have been explained in mycorrhiza (1), a symbiotic, mutually beneficial coexistence of fungi with higher plants' roots and ants' cooperation with aphids (2). In fungi, the fungus forms an extensive network connected to the tree's capillaries, increasing their ability to absorb water and nutrients several hundred times. Wood, on the other hand, supplies carbonaceous products from photosynthesis to mushrooms. An analogy is offered here with companies that decide to cooperate, for example, holding companies or clusters, thus combining their economic strength, capacity possibilities and a more significant market position: they benefit each other.

The principles of communication and teamwork were explained to students through community coexistence and patterns of wild boar's pack, wolves, big game and bees. The bee colony, which consists of tens of thousands of workers of various ages, physiological condition and odour, can only exist because it still has a continuous exchange of information through antennal contacts (by feelers), dances and vibrations. Information flows through the entire bee colony in the form of the parent substance smell. Ants are also social insects, forming castes (corporate hierarchies) communicating through pheromones and stridulation. Communication and teamwork in the company should be similarly effective and continuous, where each employee is acquainted with their inclusion in the company hierarchy and the set of activities performed. Illegal and fraudulent practices have been clarified by analogy with parasitism in an anthill and fungi: in each anthill, several parasites

take advantage of the fact that they can mimic the smell of ants, although otherwise, they are not at all similar in body structure; fungi cause damage to plants, woody plants and decomposition of wood mass, thereby weakening woody plants to death. Students showed better memorisation and understanding on issues that were explained in detail on analogies with forest habitat.

Table 2. Evaluation of Achievement Test Comparison of Groups (E) and (C)—Descriptive Statistics.

	Economic Task and Parallel with Forest	Range	C Group (<i>n</i> = 190)		E Group (<i>n</i> = 236)		Mann-Whitney U Test	
			Median (Q1; Q3)	Mean \pm sd	Median (Q1; Q3)	Mean \pm sd	z-Value	p-Value
1	General concept of sustainability (wild boars, wolves)	10 points	8.00 (4.00; 8.00)	7.36 \pm 3.39	8.00 (6.00; 10.00)	7.77 \pm 1.75	−2.76	<0.01 *
2	Establishment, termination and liquidation of company (textbook)	10 points	8.00 (4.00; 8.00)	6.44 \pm 2.73	6.00 (4.00; 8.00)	5.76 \pm 2.83	1.87	0.06
3	Capital structure (textbook)	10 points	8.00 (4.00; 8.00)	7.27 \pm 3.19	4.00 (2.00; 6.00)	4.94 \pm 2.69	7.18	<0.01 *
4	Consumer behaviour (wild boar)	10 points	4.00 (4.00; 4.00)	3.49 \pm 1.46	8.00 (6.00; 10.00)	7.84 \pm 1.76	−11.75	<0.01 *
5	Critical Path methods (ants)	20 points	12.00 (6.00; 16.00)	11.33 \pm 5.86	16.00 (14.00; 18.00)	15.84 \pm 2.70	−7.68	<0.01 *
6	Labour theory of value (Mutualism)	10 points	6.00 (2.00; 10.00)	6.34 \pm 2.49	8.00 (6.00; 8.50)	7.69 \pm 1.77	−5.40	<0.01 *
7	Resource management (Squirrels)	6 points	2.00 (2.00; 4.00)	2.66 \pm 1.08	4.00 (2.00; 4.50)	3.92 \pm 1.42	−6.69	<0.01 *
8	Investment activity (textbook)	10 points	4.00 (2.00; 8.00)	4.92 \pm 2.94	6.00 (4.00; 8.00)	6.10 \pm 2.55	−4.08	<0.01 *
9	Fibonacci sequence (cones, phylogenesis)	6 points	2.00 (2.00; 4.00)	2.77 \pm 1.17	4.00 (2.00; 5.00)	3.85 \pm 1.49	−6.35	<0.01 *
10	Cooperation models (fungi symbiosis, bees, ants, wolves, wild boars)	10 points	4.00 (2.00; 6.00)	4.70 \pm 2.71	8.00 (8.00; 10.00)	8.54 \pm 1.46	−12.36	<0.01 *
11	Adaptation and change management (golden ratio, macrogastra plicatula)	10 points	7.50 (4.00; 8.00)	6.51 \pm 2.66	8.00 (8.00; 10.00)	8.38 \pm 1.52	−6.92	<0.01 *
12	Synergistic effect (bees, ants)	4 points	2.00 (2.00; 2.00)	2.29 \pm 1.04	2.00 (2.00; 4.00)	2.93 \pm 1.00	−5.17	<0.01 *
13	Controlling and financial audit (textbook)	6 points	4.00 (4.00; 6.00)	4.11 \pm 1.47	4.00 (4.00; 6.00)	4.31 \pm 1.49	−1.22	0.22

Table 2. Cont.

	Economic Task and Parallel with Forest	Range	C Group (n = 190)		E Group (n = 236)		Mann-Whitney U Test	
			Median (Q1; Q3)	Mean \pm sd	Median (Q1; Q3)	Mean \pm sd	z-Value	p-Value
14	Illegal and fraudulent business practices (fungi parasitism)	10 points	1.00 (1.00; 1.00)	1.29 \pm 1.16	8.00 (6.00; 8.00)	7.13 \pm 2.33	−12.25	<0.01 *
15	Inventory and stock management (squirrels)	6 points	2.00 (2.00; 4.00)	3.13 \pm 1.46	6.00 (4.00; 6.00)	4.93 \pm 1.27	−9.94	<0.01 *
16	Organizational structure of company (beehive, anthill, wolves)	8 points	2.00 (2.00; 4.00)	3.04 \pm 1.48	6.00 (4.00; 8.00)	5.91 \pm 1.96	−11.48	<0.01 *
17	Horizontal and vertical cooperation (wolves and ravens)	10 points	4.00 (2.00; 4.00)	3.23 \pm 1.36	8.00 (4.00; 8.00)	6.72 \pm 2.67	−11.86	<0.01 *
18	Logarithmic spiral and optimal growth rate (<i>Sectio aurea</i>)	10 points	2.00 (2.00; 4.00)	3.00 \pm 1.80	8.00 (6.00; 10.00)	7.60 \pm 2.00	−12.23	<0.01 *
19	Human resource and diversity management (beehive, anthill)	10 points	4.00 (4.00; 6.00)	4.93 \pm 2.18	8.00 (6.00; 9.00)	7.70 \pm 1.71	−11.86	<0.01 *
20	Communication and teamwork (bees, wolves, ants)	10 points	4.00 (2.00; 4.00)	3.78 \pm 1.98	8.00 (6.00; 8.00)	7.08 \pm 2.33	−12.29	<0.01 *
21	New markets search (bees)	10 points	4.00 (2.00; 4.00)	3.97 \pm 2.24	8.00 (6.00; 10.00)	7.77 \pm 1.82	−13.78	<0.01 *

Note: * refers to statistically significant results at $\alpha = 1\%$. Source: the author's processing.

No differences between groups were found for questions (2) and (13), i.e., establishment, termination and liquidation of the company (z -value = 1.87; $p = 0.06$) and controlling, audit (z -value = 1.22; $p = 0.22$). Question No. (3) dealing with the capital structure of the company ($p < 0.01$) has a positive z -value = 7.18, which indicates that in this question, the experimental group was significantly worse compared to the control group. The explanation for this finding may be that teacher-as-researcher did not find suitable examples of these issues (company assets, external and internal sources of financing, financial leverage, optimal property structure, financial statements, potential analysis, legal aspects of founding and liquidating a company) from the forest ecosystem. These issues were taught according to economics textbooks. Group (E), which has since become accustomed to outdoor forest workshops, could negatively perceive returning to the textbook and did not have to be interested in the above topics. In contrast, for the control group, nothing changed because, in the control group, tuition took place in the standard way in the classroom with regular use of textbooks. Therefore, the teacher-as-researcher leans towards the opinion of Pruneau, Freiman, Barbier and Langis [50] that the joint work of scientists (teachers, researchers) and students using demonstration methods and problem-solving strategies brings positive results.

Based on statistical testing, it can be stated that the experimental intervention in the form of forest workshops in the group (E) led to better results compared to the control group (higher values equals a better result). For issues in which no suitable parallel with

the forest ecosystem was found and was therefore explained according to the textbook, group (E) did not perform better than group (C). The experiment in the form of forest workshops meant better test results on topics that were demonstrated on forest parallels.

3.2. Results of a Qualitative Research Survey Using Focus Groups

Results of focus groups discovered the attitudes to the given issues and the most critical aspects impacting newly identified knowledge. The questions asked created two basic thematic categories: (1) how the forest ecosystem, economic tuition and sustainable thinking are related, (2) primary analogies between forest ecosystem and business principles. The most frequent recurring statements of participants representing each of these categories are listed in Table 3. The alternation of agents' statements indicates group dynamics. Individual agents are marked with the abbreviation A + No.

Table 3. Selected statements of participants concerning the formed thematic categories.

Thematic Category Number	A Selected Statement Representing a Thematic Category (No. of Agent)
(1) how the forest ecosystem, economic tuition and sustainable thinking are related	<p>"The logic of the Fibonacci sequence and the <i>Sectio aurea</i> can be applied to corporate management, as economics is all about efficiency and optimisation. The principle of balanced growth could also be explained in the example of the <i>Sectio aurea</i>." (A32)</p> <p>"It is the setting of optimal development that should be the goal of every manager so that there is no overheating of the company or, conversely, bankruptcy." (A41)</p> <p>"The best example came from a snail shell and ants. I liked learning project management and the Critical Path Method on the example of ants the most" (A65)</p>
(2) primary analogies between forest ecosystem and business principles	<p>"I was very interested in the parallels of the spiral and the golden ratio, I had never thought before that changes, innovations and adaptations should be in a certain proportion, following the rules of the <i>Sectio aurea</i>." (A4).</p> <p>"I liked bees the most; it's like in the company, the hierarchy, the division of powers and competencies, each bee knows exactly what to do and where it is. Bee dances and the search for a new "market" like new meadows with flowers." (A17)</p> <p>"Nature has experience in survival and optimisation strategies for individual species. Processes in organisations are also vibrant and dynamic." (A18)</p> <p>"In nature, every community wants to survive, as well as the company; this logic drives everything else." (A28)</p> <p>"Collaboration increases efficiency, and competition stimulates business, and dying processes are the driving force behind innovation." (A47)</p> <p>"Understanding ecological niches encourage holistic, innovative thinking and new areas of business." (A89)</p> <p>"The growth dynamics of the organisation's potential must be in line with the market turbulence requirements and the organisation's growth gradient. Gradient and dynamics are 1.618 times the current potential of the organisation with balanced growth." (A91)</p> <p>"Spiral growth, in the form of Bernoulli's logarithmic spiral, is a picture of long-term success that we can see in nature (snail shell, hurricane vortex)." (A23)</p>

Moreover, the students reported advantages, such as reduction of shyness and productive group learning.

4. Discussion

UNESCO communicated its conceptualisation of education for sustainable development (ESD), but this message was not well received by everyone [80]. Without contextualisation and explicit links to relevant educational and philosophical theories, sustainability education risks appearing disconnected from teaching method development or evaluation [81,82]. Hill [82] suggests change must take place in three areas for educators: in philosophy, values and understandings (1), in infrastructure, resource use (2) and in teaching and learning strategies (3). It is at the nexus of these three areas that the most effective pedagogical approach can be found.

According to Næss, transformation cannot be achieved without political and economic amendments. The biggest problem is that political parties do not want such changes. Ques-

tions of Deep Ecology shake the foundations of today's human mentality [15]. Arne Næss's main endeavour was to help people develop their environmental philosophy to make society aware of the whole ecosystem and act in its prosperity. Deep Ecology understands environmental issues comprehensively; nevertheless, the goals are still quite distant today; for example, local communities' support completely overlooks the ongoing globalisation. A sharp reduction in the Earth's population to 100 million, as Næss suggests, or the abolition of centralised power—is not realistic. The way to such a radical conversion in people's current mentality and the realisation that we must act to sustain the entire ecosystem is still a long journey and leads through a large number of small steps. However, any new improvement in the human relationship with the environment can be considered as these steps. One of these steps may be establishing a transformative learning initiative similar to that proposed by Enberg and Harlap [43] and the challenge that outdoor adventure educators must collaborate on national and international levels to promote this discipline's value recommended by Potter, Socha and O'Connell [83].

4.1. Achievement Test Results and Methodology

How is it possible that the achievement test results (except for questions 2, 3, 13) turned out better in the group (E)? Researchers assume that better results were achieved because topics such as cooperation models, illegal and fraudulent practices, new markets search, communication and teamwork, consumer behaviour, optimal growth rate, critical path method, Labour theory of value, resource management, change management, inventory and stock management and synergistic effect were explained analogously on forest parallels. In issues related to the legal aspects of the establishment and dissolution of the company, controlling and auditing, the differences in the results of groups (C) and (E) were not observed. The experimental group had significantly worse results in question (3) concerning the company's capital structure. These are topics to which the teacher-as-researcher did not find appropriate analogies to the forest habitat, and the experimental group had to learn them from the textbook. These are exact, accurate corporate finance calculations, where it is not possible to involve creativity. These facts may have meant that the experimental group, already accustomed to outdoor learning, had to "back to school" to count examples, which could be unpleasant or even frustrating for these students. Nothing changed for the control group, the students were used to the classic frontal teaching in an auditorium, and therefore no change occurred for them. Based on this, it is possible to conclude that the experiential teaching method, fieldwork and outdoor learning positively affect student outcomes, consistent with many other authors [41–51]. The one who learns actively- learns effectively and can connect the newly acquired knowledge with the existing knowledge [84,85]. Standard lecture formats do induce a vigilance decrement [86].

During the fieldwork, students were continuously provided with feedback by the teacher-as-researcher. The teacher-as-researcher also found out through the formative assessment what the student has learned and decided on the next step accordingly. Formative assessment is essential for the development of critical competencies [87]. The summative assessment took place at the end of the semester in the form of an achievement test to obtain a final overview of the acquired knowledge.

4.2. ESD in Higher Education

Ramsden [88] formulated six principles of higher education, of which the fifth and sixth principles are crucial for this research: independence and active involvement of students in teaching (5) and learning from students (6). Learning from students means getting to know them as developing personalities, researching their study possibilities and styles, interests, taking into account their opinions and criticism, and then including all of this into teaching strategy. This research is perceived to have a broader meaning than learning itself. The higher education sector has the obligation and capability to instigate a 'ripple' effect in developing sustainability-literate citizens, which is also supported by Lugg [89]. The organisation of schedule at the universities enables lecturing in modules or blocks; therefore,

it is not possible to say conclusively that outdoor workshops would be more demanding in the experimental group than in the control group. The only fundamental difference lies in the forest educator's involvement, who accompanied the experimental group in the forest. The time required for one teacher in outdoor workshops is comparable to a stay at school; it depends on the organisation of the schedule and the teacher's willingness to leave the auditorium. Rumenick and Goralnik [90] examined andragogy in outdoor science education and affirm its relevance for adult (older than 18 years) university students. Wery and Thomson [91] reviewed ways to encourage students to engage more positively in their learning. Roberts [92] tested multimedia learning propositions that prompt students to become active co-producers of knowledge. Aflalo [93] suggested a student question generation model into an education setting with 133 students. The students' ability to cope with these questions improved.

4.3. Focus Groups Outcomes

Focus Groups have shown that all workshop participants now look at nature from a new perspective. Næss's words that feelings have cognitive value [15] were confirmed as what the students felt the most emotions for (what interested them the most) was also better remembered and understood. Students gained new insights into the "evolutionary biography" and see potential and structure as sustainable, practical and inspiring to solve business and national economy issues. A positive finding is that they lost shyness and were not afraid to express opinions out loud.

4.4. Limitations and Possible Follow-Up Research

This research has potential limitations relating to the number of students and time restrictions and can be regarded as pilotage. Focus groups also generate certain limits. Focus group participants can censor their claims; the participants can respond differently under the circumstances' weight than they would have done if they had been alone with the researcher. The respondents may also conveniently conform to the majority opinion or, conversely, may rebel against it. In both cases, however, it provides misleading data. Prior research studies relevant to our paper are limited (using forest animals and plants' examples to explain the principles of sustainability). This limitation can be considered a challenging opportunity to identify gaps and present the need for further sustainability development. The Kolmogorov-Smirnov test also has several limitations: it only applies to continuous distributions and tends to be more sensitive near the distribution centre than at the tails [67].

The paper aimed to compare the effectiveness of teaching methods and approaches, which could be the scope for follow-up research in a longitudinal study. Further research could encompass more parallels and involve participants in different age categories: young managers in their 30s, 40s and experienced managers at the age of 60.

Researchers could not find any relevant paper or project that would examine in such detail how to increase understanding and thinking in the context of sustainability by analogy with the forest ecosystem based on the parallels with forest habitat. Researchers are preparing a workbook of business economics based on analogies with the forest ecosystem as an "example of good practice".

This study sought to contribute to students' insight into what laws exist in nature and that if they were not set in this way, the animal or plant species would disappear. Exploring forest, students could see "live" manifestations leading to further development while maintaining the existing ones. The more people understand these natural principles, the more intensively it is possible to look for an analogous solution for the human world and apply them into the production process. When nature is understood, even better can be protected. Furthermore, last but not least, using the example of forest bees, students could understand that employees cannot be all managers.

5. Conclusions

This research aimed to identify whether the tuition of sustainability and forest awareness in analogy with the forest ecosystem using forest pedagogy methods could improve university students' sustainable understanding. Moreover, if students' proficiency in applying a sustainable mindset from a forest ecosystem to practice increased. This research's results could be relevant for policymakers and stakeholders involved in education to utilise these proposals to develop successful educational strategies and tools to promote this innovative approach. The Business Economics course tuition by analogies with nature can be beneficial for lecturers and teachers of economic subjects at secondary schools, universities, academics, managers and organisers of team-building events.

This research's urgency is evident from the deteriorating ecological situation and the need to prepare the young generation for new sustainability. Our research's general results showed that issues that were explained on the forest parallels turned out in the achievement test better than topics for which it was not possible to find appropriate analogies to the forest fauna and flora. These outcomes are consistent with some authors' recommendations for outdoor fieldwork, teamwork, experiential activities and action-oriented learning into academic tuition [41–51]. These suggestions have the potential to enrich standard academic approaches applied in universities with an economic focus.

In this experiment, researchers made an effort to prove that it makes sense to educate young people to think according to evolutionary principles that have been proven and work for billions of years on Earth. Moreover, it is possible to apply them to the economic subjects tuition. According to Chráska and Gavara [94,95], students' opinions are as valuable as objective results. Active Corporate Social Responsibility has a positive effect on the reputation and can increase employee motivation, efficiency, better image and chances of winning a public contract.

The achievement test results were also submitted to the university B, (which did not initially approve the didactic experiment) with a request for reconsideration of forest fieldwork in the future. Based on the presented results, it was promised by this university that modules enabling fieldwork would be incorporated into the schedule next year.

Even though ecological philosophy comprises different systems (e.g., deep versus shallow ecology), their output and conclusions are primarily consistent and strive for the sustainable development of life on Earth. Many of these outputs and conclusions can, therefore, be applied to education. Schweitzer, Leopold, Gándhi and Næss have something to say even today and describe the problems we solve today, so they can be considered sources of inspiration for education in the 21st century. If current and future managers, entrepreneurs and politicians understand the principle of sustainability in practice, there is a growing chance that the threat of a crisis could be reduced; the competitiveness and social responsibility of companies and national economies will increase. The presented article attempts to outline ideas for solving current economic dilemmas and sustainability, which should provoke professional discussion by considering theoretical knowledge and practical experience.

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