

Natural space as a transformative environment for children's well-being

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Abstract- Children's happiness” is the principal vector of any society and the foundation on which the Sustainable Development Goals rest today, tomorrow and for the next generation. This multidimensional term encompasses complex components, without each of which it remains incomplete. We examine the interrelation between the phenomenon of children's happiness and nature-based practices (in the context of an environment in which, through neurobiological, sensory and interpersonal mechanisms, qualitative changes take place in the child's personality, emotional repertoire, cognitive strategies and immune profile). We review existing methodologies, the international studies that have been conducted on this topic, and their results, and draw a conclusion about the most effective practices contributing to the enhancement of children's happiness. This article is unique in that it identifies a set of aspects of children's well-being, presents concrete methodologies for analysing this multifaceted concept, lays out natural factors of influence, summarises a research base on the impact of nature on the younger generation across individual components, and describes working programmes that demonstrate the action of the natural environment on children as transformative. The author argues that, from the standpoint of sustainable development, nature-oriented programmes possess a unique property: they are simultaneously a tool for achieving goals (improving children's health and well-being) and a means of forming agents of sustainable development in the next generation. Adapting the principles of the Stanford course “Interpersonal Dynamics” to nature-based programmes for children opens up the possibility of creating a new class of pedagogical products.

Keywords- Children's happiness; sustainable development; forest therapy; parasympathetic nervous system; NK cells; Mycobacterium vaccae; phytoncides; neurotransmitters; nature-based education; children's well-being measurement; forest kindergarten.

I. INTRODUCTION

Children's Happiness

Children's happiness, from the perspective of psychology and pedagogy, is a complex, multilayered phenomenon, based on a harmonious combination of safety, cognitive interest and the satisfaction of basic needs for love and recognition. In its essence, however, this state is surprisingly simple and unconditioned: an adult does not need to buy an expensive toy or take the child to an amusement park to witness genuine delight. A child is capable of becoming absorbed in the contemplation of a puddle reflected on the asphalt, or of a warm sunbeam, finding a wonder in the most ordinary moment. It is precisely this ability to rejoice “just because”, detached from social conventions and material goods, that makes children's happiness a unique and life-giving source of energy for life. This seems obvious to adults with a highly developed

ecological education, but far from everyone is aware of the scale of the consequences of the fact that, in children living in modern urban environments, the balance of the nervous system shifts towards a chronic stress reaction to constant anthropogenic factors.

Interrelated Components of Children's Well-being

Children's happiness is a multidimensional concept. Let us examine in more detail which aspects children's happiness and well-being comprise:

- subjective well-being (emotions, mood, life satisfaction);
- psychological functioning (self-esteem, confidence, meaning, competence);
- social well-being (quality of relationships, sense of belonging);
- physical health (immune profile, sleep, energy);
- neurocognitive indicators (attention, memory, creativity).

Main Instruments and Scales for Studying the Components of Children's Well-being

A combination of psychological scales, neurotransmitter and immune profiles (in particular NK cells), sensory and neurophysiological data makes it possible to capture the effect of children's activities and to understand the mechanisms through which it is realised (Tables 1–2).

Table 1. Psychological and behavioural instruments.

Criterion	Tool (research methodology)	Age of study participants	Metric
Subjective well-being	SLSS (Students' Life Satisfaction Scale; Huebner, 1991)	8–18 years	7 items, Likert scale
Mood and emotions	PANAS-C (Positive and Negative Affect Schedule for Children)	8–18 years	Positive / negative affect
Anxiety	SCARED (Screen for Child Anxiety Related Disorders)	8–18 years	41 items, 5 subscales
Self-esteem and confidence	Rosenberg Self-Esteem Scale (adolescents) / Harter Self-Perception Profile (children)	6–18 years	Global self-esteem + domains
Social-emotional skills	SDQ (Strengths and Difficulties Questionnaire)	4–17 years	5 subscales, parent + teacher
Mindfulness	CAMM (Child and Adolescent Mindfulness Measure)	10–17 years	10 items
Connectedness to nature	CNI (Children's Nature Connection Index; Richardson et al., 2019)	5–14 years	16 items
Openness / role flexibility	PF-16 adaptation (Flexibility / Role Rigidity subscale)	8–16 years	Adapted scale

For pre-school-age children (3–7 years), psychological scales can be replaced by projective and observational methods: the "Children's Faces Scale"[4], structured observation in standardised play situations following the PACS protocol (Play Assessment and Classification System), and parent diaries with semi-structured questions about behaviour and affective states. Neurotransmitter and hormonal profile: this is one of the most objective biomarkers of changes in the state of the nervous system. The proposed protocol includes the following markers,

determined in samples of saliva (cortisol, alpha-amylase), urine (serotonin, dopamine, noradrenaline) and blood (Table 2).

Brain-derived neurotrophic factor in blood serum has acquired particular significance in the context of nature-based programmes: a study by Yanagisawa [29] showed that a 2-hour walk in a forest has a direct relevance for neuroplasticity and cognitive development.

Table 2. Immune profile: NK cells and inflammatory markers.

Biomarker	Collection method	Expected effect (T0→T1)
Cortisol	Saliva, 3 morning samples	↓ 10–20%
Salivary alpha-amylase	Saliva	↓ 15–25%
Serotonin	24-hour urine	↑ 15–30%
Dopamine	24-hour urine	↑ 10–20%
Brain-derived neurotrophic factor	Blood serum	↑ 12–20%
NK cells (count)	Peripheral blood	↑ 20–40%
NK cells (activity)	Peripheral blood	↑ 40–60%
Granzyme B / Perforin	Peripheral blood	↑ 30–50%
Inflammation markers	Blood serum	↓ 10–25%
Secretory immunoglobulin	Saliva	↑ 10–20%

Sensory systems and sleep quality: the natural environment affects all of a child's sensory systems, and the methodology includes their specific assessment. The quality of vision is assessed using near and far visual indicators with an autorefractometer: data indicate [8] that each additional hour spent outdoors reduces the risk of myopia progression by 2–3%, and bright natural light ($\geq 10\,000$ lux) stimulates the release of dopamine in the retina, slowing axial elongation of the eye.

Auditory acuity and auditory discrimination (the ability to single out a signal from noise) are assessed using standard audiometry and the SCAN-3 test. Importantly, natural soundscapes (biophony - birdsong, the babbling of water, the rustle of leaves) with regular exposure improve auditory discrimination and reduce the symptoms of auditory fatigue characteristic of urban children.

Olfaction is assessed using the standardised Sniffin' Sticks test (perception thresholds, discrimination, identification). Tactile

sensitivity is assessed with the Semmes–Weinstein test (pressure) and an evaluation of "tactile defensiveness" using the sensory-integration protocol. Children with high tactile defensiveness, as a rule, avoid contact with nature — and it is for them, in particular, that nature-based programmes may be most therapeutically significant. Sleep quality is measured accelerometrically (a three-axis wrist accelerometer, Sadeh method): total sleep time, sleep efficiency, sleep latency, the proportion of slow-wave sleep and REM phase are assessed. Additionally - the subjective Pittsburgh Sleep Quality Index (PSQI) in a children's adaptation and data on nocturnal melatonin release (in morning urine). Children attending nature-based programmes with overnight stays demonstrate, by the fourth day, a statistically significant increase in melatonin profile, which the authors associate with the restoration of circadian rhythms under conditions of the natural light cycle [10].

Hypothesis: an increase in the level of children's happiness is associated with the child's time spent in nature.

It is fundamentally important to distinguish between two approaches to nature in the context of children's programmes. The first regards nature as a tourist product - a picturesque background for leisure, a subject of environmental education, a recreational resource. The second - and it is precisely this one that is the subject of the present article - understands nature as a medium of transformation. The difference between these approaches is not quantitative (length of stay) but qualitative: it is determined by how the child's presence in the natural environment is organised.

Factors That May Be Implicated in Changing the Level of Children's Well-being

- biophony - birdsong, the babbling of water, the rustle of leaves;
- natural sensory contact;
- the practice of breathing fresh air;
- contact with soil;
- phytoncides and natural aromas;
- active outdoor play.

The identified factors should be analysed sequentially: 3–7 days before the start of the nature-based programmes (T0), immediately upon completion (T1) and 4–8 weeks after completion (T2), which makes it possible to evaluate both the immediate and the lasting effect.

II. EVIDENCE BASE OF RESEARCH

Let us analyse what research has been carried out at the intersection of well-being metrics and the factors contributing to improvement, and evaluate the results.

The Autonomic Nervous System and Parasympathetic Activation

It functions in a regime of dynamic balance between the sympathetic (mobilisation) and parasympathetic (restoration) divisions. In children living in modern urban environments (Fig. 1), this balance is systematically shifted towards chronic sympathetic dominance, which is manifested in an elevated cortisol level, low heart-rate variability and a lowered threshold of stress reaction [13].

Being in the natural environment triggers a complex of parasympathetic effects documented in the neurobiological literature. The key instrumental marker is the high-frequency component of heart-rate variability. In a randomised controlled trial [5] carried out on 156 Korean schoolchildren aged 9–12 years, a three-day forest camp produced an 18.7% improvement in heart-rate metrics compared with an urban control group. In parallel, the authors recorded a 22.4% reduction in the amplitude of the galvanic skin response — a marker of sympathetic activation.

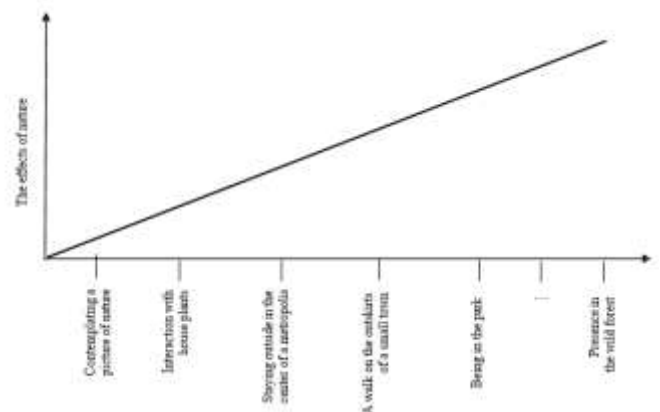


Fig. 1. Dependence of the effectiveness of nature's possibilities on the conditions of its application (author's own).

An evolutionarily new approach to the study of the parasympathetic system was Stephen Porges's theory, according to which the parasympathetic system provides not just physiological inhibition, but a state of "safe connection":

social openness, curiosity, playfulness. It is this state, according to Porges, that is optimal for learning and for the unfolding of potential. The natural environment - with its rhythmic sounds (the rustle of leaves, birdsong), moderate sensory richness and absence of social pressure - acts significantly more effectively than a classroom.

Regulation of the Prefrontal-Cortex Axis and Reduction of Background Anxiety

Chronic anxiety in children is realised through hyperactivation of the hypothalamic–pituitary–adrenal axis, which leads to consistently elevated cortisol concentrations and, over time, to structural changes in the prefrontal cortex and hippocampus - zones critically important for the regulation of emotions and the formation of memory [14]. This dynamic is especially pronounced in children with anxiety disorders and post-traumatic conditions.

A meta-analysis covering 14 studies (1 247 participants, aged 4–17 years) [22] showed that systematic nature-oriented interventions lasting from 8 to 12 weeks reduce salivary cortisol concentration by an average of 14.6%. The effect was significantly more pronounced in children with an initially high level of anxiety and in children from low-income families, indicating the potential of nature-based programmes as an instrument for reducing inequalities in mental health.

The temporal dimension is fundamentally important: according to data from a Japanese study [18], a statistically significant decrease in cortisol is recorded already after a 20-minute walk in a forest environment (compared with a walk in an urban one). However, it is precisely the cumulative effect of regular natural exposures that forms stable neural patterns reducing the reactivity of the adrenal axis. This distinction between acute and chronic effect has critical significance for programme design: one-off "outings" provide temporary relief, whereas only systematic interaction with nature ensures transformation of the neurobiological basis of anxiety.

Unfolding Potential: Prefrontal Cortex, Attention and Creativity

One of the most significant, yet least publicly discussed, effects of the natural environment is its impact on the prefrontal cortex - the region of the brain responsible for voluntary attention, cognitive control, decision-making and creative thinking. At the basis of this impact lies attention-restoration theory [11], which has received powerful neuroscientific confirmation in the 2020s.

A study using functional near-infrared spectroscopy demonstrated that, in children aged 8–11 years, after a 45-minute walk in a forest park the process of oxygen saturation of brain tissue during a subsequent attention-concentration test was significantly higher than after an equivalent-length stay in an urban environment ($\Delta = 12.3\%$, $p = 0.008$) [25].

Kaplan's concept of "soft fascination" explains this effect: natural stimuli — clouds, flowing water, fire, foliage - draw attention involuntarily and without competition, allowing the prefrontal cortex to "reboot". Unlike the urban environment, which requires continuous voluntary attention (traffic-light signals, streams of cars, social norms), nature restores its depleted resources. For children this is especially critical: it is precisely the resources of the prefrontal cortex that secure not only academic success but also emotional intelligence, impulse control, and - crucially - the capacity for play and creative exploration of the world, i.e. for the unfolding of potential.

The Loosening of "Rigid Roles" in the Natural Environment

The phenomenon of the "rigid role" - a stable behavioural pattern assigned to a child by a group or family ("excellent pupil", "clown", "quiet one", "problem child") — is well described in pedagogical psychology; however, its neurobiological foundations and the conditions for overcoming it have been studied in significantly less detail. The natural environment possesses a number of unique properties that systemically destabilise rigid roles. First, nature levels social status: outside the habitual context (classroom, courtyard, family), former hierarchical patterns lose their automatism. The "academically unsuccessful" child turns out to be a fine tracker; the "quiet one" demonstrates fearlessness when crossing a stream. A study on a sample of 312 children at summer nature camps in the USA showed that 67% of children who initially occupied low-status positions in their school group had, by the end of a two-week camp, been re-evaluated by peers as "competent" or as "leaders" — and this re-evaluation persisted over six months [7]. Second, nature offers indeterminate, "unscripted" tasks — building a shelter, finding a path, kindling a fire - for which there are no ready-made role scripts. In neuroscientific terms, this corresponds to activation of the "default mode network", responsible for creative imagination and self-exploration. According to the data, natural conditions help the child construct a narrative of self that is free from imposed roles [9].

The Microbiome of the Natural Environment: Soil Bacteria

For a children's audience, data investigating the impact of contact with soil on children aged 4–10 years are fundamentally important [23]. Children who regularly played in a vegetable garden or in a natural environment with unprotected hands (a minimum of 30 minutes three times a week) demonstrated significantly higher urinary serotonin concentrations, lower behavioural-problem scores on the SDQ (Strengths and Difficulties Questionnaire) and improved sleep quality on accelerometric data. The authors proposed the term "microbial antidepressant" to designate "M. vaccae", emphasising that the simple act of touching untreated soil is a form of natural neurochemical intervention. For children's programmes this means the following: it is not sterile pathways and safe playground surfaces, but living earth, leaf litter, clay and natural sand with organic admixtures that are the carriers of neurochemically active biodiversity. Conscious contact with soil, its smell (geosmin — one of the most powerful olfactory triggers of a feeling of calm in humans) and texture is not a risk but a therapy.

Phytoncides: Essential Oils of Plants

A parallel and complementary mechanism is the action of plant volatile organic compounds - known as phytoncides - on the immune and nervous systems. The Japanese scientific school under the leadership of Qing Li has built the most complete evidence base in this field as applied to children. In a controlled study [12], 48 children aged 8–12 years spent three days in a coniferous forest on the island of Yakushima. Blood analysis before and after showed: NK-cell activity increased by 56.3%, the number of NK cells rose by 23.4%. Importantly, this immune effect persisted 30 days after returning to the city. In the control group (urban holiday without a forest) no analogous changes were detected. The authors identified α -pinene as the main active agent, the concentration of which in forest air exceeds the urban background by a factor of 20–100.

With regard to essential oils for children's programmes, data are important [6] showing that the controlled use of lavender-oil diffusers (2–4 mg/m³) in a nature-camp children's dormitory reduced sleep latency by 18 minutes and increased the proportion of slow-wave sleep by 14.2%. Cedar-oil inhalation in children aged 6–10 years reduced scores on the SCARED children's anxiety scale by 19.4% over a 4-week period of use [17]. These data make it possible to integrate plant-based aromatherapy into the protocol of nature-based programmes as

a scientifically grounded instrument for supporting the nervous system.

III. NATURE-ORIENTED CHILDREN'S PROGRAMMES

Having reviewed the research findings, let us examine programmes and practices that successfully implement the task of raising the level of children's happiness.

From Shinrin-yoku to Children's Forest Therapy

A systematic review encompassing 22 studies of nature-based educational programmes with the participation of 3 758 children of pre-school and school age revealed reliable positive effects: an improvement in social-emotional skills [16] (social connectedness, empathy, conflict resolution) was observed in 81.8% of studies; a reduction in symptoms of attention-deficit/hyperactivity disorder (ADHD) - in 72.7%; an improvement in physical fitness - in 77.3%. The authors emphasise that pedagogically unstructured contact with nature produced a significantly smaller effect than methodically organised programmes.

Nature as a Non-Linear Educational Environment

The fundamental property of nature as an educational environment is its unpredictability. Unlike the classroom, where the teacher controls the variables, nature confronts the child with "open tasks" without a single correct answer: to find a path through an unfamiliar forest, to cope with sudden rain, to negotiate the distribution of resources around the campfire. These situations activate what Lewis Mumford called "dynamic intelligence" - a complex of adaptive abilities that is sharply suppressed by standardised teaching.

A study conducted in Danish forest kindergartens showed that children taught in nature for 2–3 days a week throughout the academic year demonstrated significantly higher "tolerance for uncertainty" and "initiative" compared with a traditional-kindergarten control group [28]. The authors associate this effect with the regular experience of "manageable instability" - situations in which the child experiences mild stress but has the resources to overcome it: what Vygotsky would have called action in the "zone of proximal development", and what contemporary psychology calls "optimal stress", or "eustress". Understanding nature not as a tourist service ("went to the forest - came home") requires a fundamentally different

programme design: lengthy stays (from 3 to 14 days and more), systematic integration of nature-based practices into the weekly rhythm of a children's institution, the creation of "favourite places" - personal natural spaces to which the child returns with growing depth of attachment. It is precisely this depth of connection with a particular place, according to researchers' data [27], that is the best predictor of long-term ecological behaviour and of the ecological identity of the adult.

Implementation of the Children's "Touchy Feely" Course

In discussing the possibilities for raising children's level of happiness, one cannot avoid describing a course of the Stanford Graduate School of Business which has been taught since 1968 and which has retained the status of the most popular elective course at the GSB for decades - the course "Interpersonal Dynamics" ("Touchy Feely") - which represents a group experience of intensive self-knowledge through interpersonal feedback.

A study [19] conducted on a cohort of graduates of the course from 2015–2022 (N = 847) showed that 78% of participants rate it as "the most transformative educational experience at the GSB", and that they name as the key effect not the acquisition of knowledge but a change in patterns of self-perception and interpersonal behaviour. These effects turned out to be lasting: 71% of participants reported that the changes persisted three or more years later.

A direct transfer of the "Touchy Feely" methodology to a children's audience is impossible: the verbal cognitive apparatus required for reflection on interpersonal influence forms in full only by the age of 11–13. The principles of the course, however, allow for age-appropriate adaptation through bodily, play and narrative formats, which the natural environment supports particularly well:

The first principle - psychological safety - is realised in the natural context through a reduction in academic pressure, the absence of grades and gadgets, a slow tempo and the possibility of solitude. Nature is itself a regulator of safety: the open sky, the horizon, the cyclical nature of natural processes create a neurobiologically calming background. The Facilitated Circle - a daily shared circle around the campfire or in a clearing - is a direct analogue of the T-group of the "Touchy Feely" course in a form accessible to children: each participant shares one observation, feeling or discovery of the day; the others listen without judgement.

The second principle - "here and now" - nature realises radically more effectively than any classroom: rain that begins during a hike, a beetle crawling on the hand, the smell of a fire - all of this demands an immediate, embodied, urgent presence. This is "compulsory mindfulness" that does not need to be specially cultivated - it is enough not to block it out with screens and schedules. A study [24] showed that children in nature camps displayed the indicator of "episodes of full immersion in current experience" 3.4 times more often than in an urban environment, according to the experience-sampling method.

The third principle - authentic feedback - can be adapted through instruments that appeal to concrete actions in natural activity, rather than to abstract personal characteristics. "When you helped me cross the stream, I felt that I could lean on you" - this is a precise analogue of the Stanford feedback formula, but embedded in a living shared experience. The "Companion Letters" protocol - written messages from participants to one another at the end of the programme - is a tried and tested format for children aged 9 and older.

The fourth principle - removal of the mask through vulnerability - is realised by nature through "de-roling": in a situation of unfamiliar terrain, physical exertion or a natural challenge, habitual social masks cease to work. This effect is particularly pronounced during night-time observation of the stars, during the joint lighting of a fire, and during the first independent overnight stays under the open sky. It is precisely here that what Stanford created its course for takes place: contact with one's real self in the presence of others ready to accept that contact.

Forest Kindergartens, Schools, Camps and Field-Camps

The principles of transformative nature-based pedagogy admit of application in several organisational formats that differ in intensity and age coverage. The nature kindergarten is the most radical form: 80–90% of the time, children (3–6 years) are outdoors in any weather, in real nature, with a minimum of structured lessons. The Scandinavian and German models of forest kindergartens have a history of more than 70 years and are currently represented by more than 3 000 institutions across Europe [3]. The origin of this approach was laid down in Sweden from the 1950s. In 1957, G. Frohm created the Skogsmulle school (Swedish skog - "forest", Mulle - the name of a character inhabiting the forest - a fairy-tale troll who, together with his friends Fjällfina, Laxe and Nova, plays, sings and tells children about nature) [21], proceeding rightly from

the fact that sensory impressions and sensual experiences in the course of regular visits to the forest compensate children aged 5–6 for the difficulties of modern life, reuniting them with nature. Over almost 60 years of existence more than 1.5 million people have taken part in this programme (approximately every fifth child in Sweden).

School nature days assume a regular transfer of part of the learning process - 1–2 days a week - out into nature. A systematic review showed that pupils of schools participating in forest-based programmes demonstrated significantly better results in mathematics (SMD = 0.31), the natural sciences (SMD = 0.44) and socio-emotional competencies (SMD = 0.52) compared with control classes - with equal curricula [1]. Intensive nature camps (5–21 days, from regional to international format) are the most-studied format of transformative impact. A meta-analysis [2] on the data of 197 studies and 29 543 children and adolescents revealed stable average effects of nature camps on self-efficacy (SMD = 0.52), resilience (SMD = 0.47) and well-being (SMD = 0.38). Moreover, the effects in samples drawn from vulnerable population groups were consistently higher, which confirms the potential of nature-based programmes as an instrument of social justice in the field of health.

Urban nature walks (guided nature-walks programmes for schoolchildren in urban forest parks, as part of the school curriculum or extracurricular activities) are the most accessible format for mass application. A study in four American cities (Chicago, Denver, Atlanta, San Antonio) showed [20] that weekly one-hour nature walks over the course of a school semester significantly reduced symptoms of depression and anxiety in schoolchildren aged 10–14 years (MASC: $d = -0.41$) and improved their academic motivation (AMS: $d = 0.36$). Studies were also conducted by us, as the creators of the "Friluftsliv" forest school, and as a result of weekly walks with schoolchildren aged 6–11 years over 3 months, the children, among other effects, showed an increased level of empathy towards natural beings and processes [15].

Natural Space as an Environment of Health and Education

Taken together, the data examined make it possible to assert that natural contact - properly systematised and methodologically organised - is one of the most powerful non-pharmacological instruments for supporting children's health and development available to contemporary pedagogy. Nature acts simultaneously at the neurobiological (neurotransmitters,

adrenal axis, autonomic nervous system), immunological (NK cells, cytokine profile), sensory (vision, hearing, olfaction, tactility) and psychosocial levels - and it is precisely this multilevel character that makes the natural environment fundamentally distinct from any single therapeutic or educational method.

Of fundamental importance for shaping policy is the distinction between "presence in nature" as a form of leisure and "natural transformation" as a systemic pedagogical strategy. The first requires only the availability of a park or forest and a parent's willingness to let the child go. The second requires professionally trained forest-therapy guides (in Japan by 2024 more than 4 000 specialists are certified; in Europe — about 1 200), methodologically developed programmes integrated into the system of children's institutions, and a system for assessing effects.

The data indicate that the greatest barriers to the implementation of nature-based programmes are not financial but institutional and cultural: a normative fear of the "risks" of contact with nature (injuries, insect bites, colds from getting wet), the orientation of education towards measurable academic outcomes at the expense of holistic development, and- in countries of the post-Soviet space — a shortage of professional infrastructure for nature-based pedagogy. Overcoming these barriers demands both political will (the inclusion of nature-based programmes in pre-school and school education standards) and a system for training teachers and parents.

From the standpoint of sustainable development, nature-oriented programmes possess a unique property: they are simultaneously an instrument for achieving goals (improving children's health and well-being) and a means of forming agents of sustainable development in the next generation. Thus, near Stuttgart in Germany there is the "House of the Forest" (German Haus des Waldes), the aim of which is precisely education for sustainable development. The concept of this centre proceeds from the fact that the forest - one of the most natural places in the surrounding cultural landscape - has great significance as a habitat for many species of animals and plants, and also serves people [26]. A child who has a deep affective connection with particular natural places is more likely to grow into an adult ready to defend nature - not out of an abstract ecological duty, but out of personal love and the experience of belonging.

IV. CONCLUSION

Nature is not merely a pleasant addition to children's education - it represents a biologically adequate environment for the development of the child's nervous system, which over the course of evolution was formed precisely under conditions of such contact. Depriving children of systematic interaction with living nature should be regarded as a systemic risk factor, comparable in its consequences with a deficit of sleep or of physical activity.

The methodology of multidimensional measurement of children's happiness in the context of nature-oriented programmes proposed in this article provides an evidence base for managerial decision-making in education and healthcare. The combination of psychological scales, neurotransmitter and immune profiles (in particular NK cells), sensory and neurophysiological data makes it possible not only to record the effect of programmes but also to understand through which mechanisms this effect is realised - which is critically important for evidence-based programme design.

The adaptation of the principles of the Stanford "Interpersonal Dynamics" course to nature-based programmes for children opens up the possibility of creating a new class of pedagogical products: experiential-transformative nature-based programmes that combine evidence-based neuroscience, forest-therapy practices and the principles of creating a psychologically safe space for authentic self-expression. Such programmes can be implemented in the formats of forest kindergartens, school nature days, intensive nature camps and structured nature walks - depending on age, available resources and institutional capabilities.

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