

Nature Intelligence in Schoolchildren

Theoretical and empirical analysis of
a conceptual model to measure children's
competencies to connect to nature



Colophon

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Introduction

This report explores how Nature Intelligence (NQ) can serve as a multidimensional framework for reconnecting school-aged children with nature through environmental education. It provides a theoretical foundation for a European partnership aiming to develop a nature-based pedagogical vision and to embed this vision within school curricula. The report also considers the diverse contexts of nature education across different countries, addressing both shared challenges and local opportunities.

A distinction is made between older children in upper grades (ages 9–12) and younger children in the lower grades (ages 5–8), allowing for age-appropriate strategies to foster NQ across key developmental stages.

This report consists of five parts:

1. A review of theory and research on the relationship between nature and children that provides insights and guidance for initiatives to (re)connect children with nature.
2. An introduction of a model of children’s key competencies to connect to nature, based on the concept of Nature Intelligence (or NQ).
3. A validation of the model against descriptions of children with a high NQ as observed by nature educators and school teachers during field work.
4. The development and evaluation of an NQ self-test for older schoolchildren and an adult-assessed test for younger children.
5. Conclusions and insights.



Theoretical background

Reconnecting children to nature

Modern children are surrounded by a wealth of electronic media—televisions, computers, smartphones—that often draw them indoors, at the cost of outdoor play in natural environments. Urbanisation further intensifies the issue by limiting safe spaces for outdoor recreation, leading parents to restrict outdoor activities to safeguard against traffic dangers and strangers. As a result, a growing number of children find themselves disconnected from nature and the outdoors, spending much less time in nature than their parents and grandparents used to do (Natural England, 2009). Concerns are mounting that this detachment could adversely affect children's development, health, and overall well-being. This anxiety has given rise to the concept of 'nature deficit disorder', signifying the potential repercussions of children's estrangement from the natural world (Louv, 2005).

To fix children's broken relationship with nature, a surge of initiatives in countries across the world have aimed at (re)connecting children with nature, especially those from deprived backgrounds with limited ability or opportunity to engage with green space. Many of these initiatives have focused on 'bringing nature to children' by greening of places in their living environment, such as schoolyards, classrooms, urban public spaces, and even children's hospitals (Van Dijk-Wesselius, Maas, Hovinga, Van Vugt, & Van den Berg, 2018). Other initiatives have aimed at 'bringing children to nature' by encouraging children to actively participate in nature-based activities (Barrable & Booth, 2020). These activities range from organised nature education programs and activities like school gardening or holiday camps, to more therapeutic interventions for children with a defined need, like outdoor adventure therapy or care farming.

While initiatives to connect children to nature mostly rely on practical experiences and insights, there is also a body of scientific research that provides relevant insights and guidelines. In this introductory chapter we give a brief review of this literature.

Childhood Experiences with Nature

There is a long-standing tradition of qualitative research documenting children's nature experiences (see for some early papers, Hart, 1979; Lynch, 1977; Moore, 1980). This research employs a variety of approaches such as direct observation of play, eliciting narratives about experiences, maintaining diaries, making photos, and creating sketches of preferred locations. Results highlight how children describe or

depict nature through living and non-living things as well as through outdoor activities. For example, a study among American children with ADHD found that children's drawings depicted nature directly, including mountains, birds, and sunshine, as well as indirectly in outdoor activities, such as swimming, building sandcastles, or fishing (Barfield & Driessnack, 2018).

Qualitative research also shows how children experience nature with all their senses, thereby showing that for children, nature is not an abstract phenomenon but a lived experience (Arola et al., 2022). Children experience nature as a process of relating with nature through touch, sight, hearing, smell and taste. For example, when asked to describe their home landscape, girls living in Northern Finland emphasized the greenness of the leaves, the brightness of the stars, and the smells of the swamps (Wiens, Kyngäs, & Pölkki, 2016) Similarly, indigenous youth in Canada have been found to experience nature through the circularity of seasons (Hatala, Njeze, Morton, Pearl, & Bird-Naytowhow, 2020).

Active engagement with nature, where children employ all their senses and physical capacities, has the potential to evoke impactful 'peak experiences' that make a lasting impression that resonates throughout the lifespan. Among these experiences are flow experiences, significant life experiences, sublime experiences, and magical moments (Chawla, 2002; Verboom & De Vries, 2006).

Table 1. Typology of peak experiences with nature, adapted from Verboom and De Vries (2006).

	Flow experiences	Significant life experiences	Sublime experiences	Magical moments
Examples	Making a dam in a river, building a shelter, taking care of an animal	Getting lost in the forest or a confrontation with a (wild) animal	Enraptured by the majestic beauty of large trees or mountains	Intrigued by the beauty of nature or the growing process of a seed
Psychological state	Synergy of mind, senses and body. A deep focus and concentration	Conquer your fears, feeling of mastery.	A mix of arousal, pleasure, and vitality, together with feelings of awe in nature	Being grasped by something that you've never sensed before
Social context	Alone, preferably without peers or adult supervision	Alone or with peers. Adults can function as a role model	Alone or shared with peers or adults. No supervision by adults	Alone or with adults. Adults can facilitate by guiding attention
Availability of nature	Proximate and easily accessible nature	Access and accessibility to nature, preferable wild nature areas	Dramatic, impressive settings (seas, mountains, forests, clouds)	A rich sensory nature environment

As illustrated in Table 1, peak experiences often imply a certain level of anxiety. However, excessive anxiety may lead to an unfavourable response to the experience. The right balance of anxiety varies among individuals, depending on their 'entry level' of mental and physical skills. What is experienced as shocking for some children (e.g., picking up an insect with your bare hands) can be too plain or boring for other children to make a lasting impression.

Connectedness to nature

In recent years, research on children and nature has increasingly focused on connectedness to nature as a crucial outcome of childhood nature experiences. The concept of connectedness to nature generally refers to an individuals' subjective sense of the closeness of their relationship with nature. Various operationalisations have been employed to measure nature connectedness. Table 2 gives an overview of six of the most used measures suitable for schoolchildren.

The key dimensions of nature connectedness included in these measures relate to emotional attraction and affiliation with nature and understanding the interdependence of humans and nature. Most of the measures are aimed at older children who have the cognitive capabilities to answer questions about their relationship with nature.

The emphasis on the interdependence between humans and nature aligns with the animistic thinking commonly found in children. In their worldview, relationships with nature are seen as reciprocal, where talking to animals and trees is believed to elicit responses. This may go against common Western notions that human-nature relationships are one-sided, with nature being seen as inanimate and non-responsive (Harvey, 2005). Indeed, animistic thinking of nature as ensouled and communicative is typically framed as an 'error' that should be corrected. However, all children have (presumably innate) tendencies to view nature as animate and ensouled. Nurturing these tendencies, instead of correcting them, provides a crucial pathway to establishing a meaningful connection with nature. This may require a cultural shift in nature education away from Western ideas towards more indigenous animistic views of nature, in order to fix children's broken relationship with the natural world.

Importantly, general knowledge about nature (e.g., knowing the names of plants and animals) and (intention) to engage in pro-environmental behaviour are not included in most measures of nature connectedness in children. These are typically treated as separate but related aspects of the human-nature relationship.



The social dimension of experiencing nature connectedness as a member of a group is largely missing from the various measures, which seems an omission, given that children spend most of their time engaging with the world in the presence of children and adults. As noted by Chawla (2020), this omission may reflect researchers' tendency to adapt measures of nature connection for children, rather than beginning from scratch with qualitative observations of children in nature.

Table 2. Measures of nature connection designed for children.

Measure and study	Sample	Dimensions of nature connection
Connection to Nature Index (CNI) 16-item survey <i>(Cheng & Monroe, 2012)</i>	9- to 10-year-olds in Florida public schools, USA	<ul style="list-style-type: none"> • Enjoyment of nature • Empathy for animals and plants • Sense of oneness • Sense of responsibility
Children's Environmental Perceptions Scale (CEPS) 16-item survey <i>(Larson, Castleberry, & Green, 2010)</i>	6- to 13-year-olds in Georgia, USA	<ul style="list-style-type: none"> • Eco-affinity • Eco-awareness
Nature Connection Index (NCI) 6-item survey <i>(Richardson et al., 2019)</i>	7- to 15-year-olds in the United Kingdom	<ul style="list-style-type: none"> • Wanting to be in nature • Feeling happy in nature • Finding beauty in nature • Finding nature amazing • Feeling part of nature • Treating nature with respect
Nature Connectedness Inventory 11-item survey <i>(Ernst & Theimer, 2011)</i>	8- to 17-year-olds in USA	<ul style="list-style-type: none"> • Viewing oneself as egalitarian member the natural world • Kinship with the natural community • Belonging to the natural world • One's welfare is related to welfare of the natural world • Enjoyment and comfort in nature
Implicit Association Test (IAT) Computer game <i>(Bruni & Schultz, 2010)</i>	10- to 12-year-olds in public school in California, USA	<ul style="list-style-type: none"> • Implicit associations between self and concepts of natural versus built
Illustrated Inclusion of Nature in Self-Test (IINS) Graphical test with circles <i>(Kleespies, Braun, Dierkes, & Wenzel, 2021)</i>	9- to 14 year-olds from a German school for students with special needs	<ul style="list-style-type: none"> • Viewing nature as part of self

Factors that shape children’s nature connectedness

A large-scale study with data from groups of English children and adults showed that nature connectedness, as measured by the NCI, varies across the lifespan, with a dip in the teenage years (Richardson et al., 2019) and peaks in childhood and later life. Notable, as shown in Figure 1, within the group of school-aged children there is also a difference between the younger age group (7-9) and the older age group (10-12) with the latter having significantly lower scores. The decline in nature connectedness from early primary school to high-school years has been confirmed by many studies in different countries (Krettenauer, Wang, Jia, & Yao, 2020; Liefländer, Fröhlich, Bogner, & Schultz, 2013).

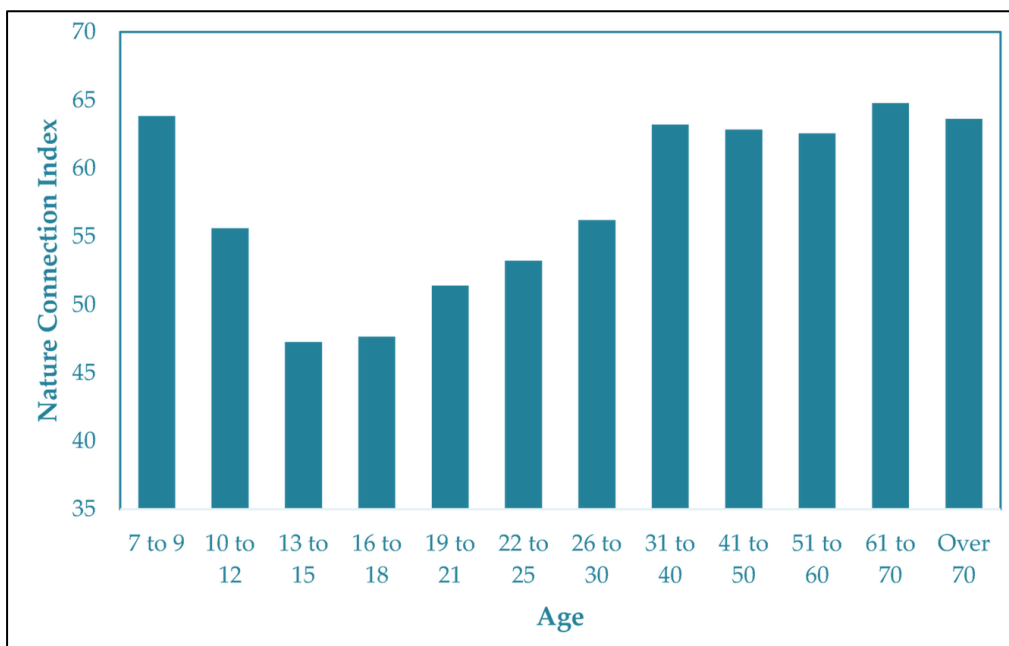


Figure 1. Mean nature connectedness scores (measured by the NCI) across the lifespan, based on a sample of 3919 participants. From (Richardson et al., 2019).

Levels of nature connectedness have reported to be higher in girls than in boys (Price et al., 2022), but the relationship with gender is somewhat mixed, depending on how connectedness is measured and in which part of the world a child lives (Larson et al., 2019).

Several studies have found that children's levels of connectedness are higher when parents believe it is important for their children to experience nature outdoors and when parents are more connected to nature (Ahmetoglu, 2019; Price et al., 2022). However, as noted by Barrable and Booth (2020) nature connectedness may also be partly a general, innate property shared across many children.

Benefits of connecting with nature

Qualitative studies describe how children enjoy the immediate positive effects of connecting with nature on their psychological well-being (Arola et al., 2022). These effects include a reduction of stress and other restorative effects, improved mood, absence of anxiety, and self-satisfaction. For example, as one child in a study by Wiens et al (2016, p. 6) said: *"I just think about the nature and everything that is related to it, and this gives me a positive spirit."* The psychological benefits of connecting with nature are confirmed by quantitative studies, showing for example that children with high scores on measures of nature connectedness are happier than children with lower scores (Barrera-Hernández, Sotelo-Castillo, Echeverría-Castro, & Tapia-Fonllem, 2020). Notably, children do not yet actively seek out nature for their health and well-being, they experience the positive effects in the moment, as an automatic outcome of being in nature.

The benefits of childhood time in nature last throughout the life-span. Numerous studies have shown that levels of nature connectedness in adults are positively correlated with happiness, meaningfulness, vitality and other indicators of mental well-being (Capaldi, Dopko, & Zelenski, 2014; Cervinka, Röderer, & Hefler, 2012) and pro-environmental behaviours (Barragan-Jason, de Mazancourt, Parmesan, Singer, & Loreau, 2022). Given that the bond with nature is primarily formed in childhood years (e.g. Cleary, Fielding, Murray, & Roiko, 2020), this suggests a life-long positive impact of childhood nature experiences. In support of this idea, retrospective studies have revealed that adults who engaged in nature-based activities at a young age exhibit more life satisfaction and more pro-environmental behaviours and attitudes in adult life (Pensini, Horn, & Caltabiano, 2016; Wells & Lekies, 2006).

The development from childhood nature experiences to adult well-being and environmentalism is believed to entail a gradual process. Children initially form attachments to specific natural sites, gradually extending these feelings to encompass nature at large. In adults, this connection to nature translates into greater happiness and pro-environmental behaviour, suggesting a potential "happy path to sustainability" founded on fostering children's affinity with nature (Nisbet & Zelenski, 2011).

Pathways to nature connectedness

Providing access alone is not sufficient for children to build a closer relationship with nature. For example, a large-scale study in England found that children's visits to nature and the amount of green space did not predict their level of nature-connectedness (Passmore et al., 2021). In contrast, activities that encourage

children to actively notice things in nature are effective in strengthening the bond with nature (Richardson & Sheffield, 2017).

Recent work by the university of Derby has identified five 'pathways to nature connection': contact, emotion, meaning, compassion, and beauty (Lumber, Richardson, & Sheffield, 2017, see Figure 2). This framework has become a source of inspiration for nature educators to develop interventions to promote children's bond with nature such as taking photos, walking barefoot, or talking about the meaning of nature (See for for more inspiration: Scouts England, 2024). However, the model does not articulate the critical competencies required for success in each pathway, which introduces a challenge when it comes to create effective and targeted educational strategies.

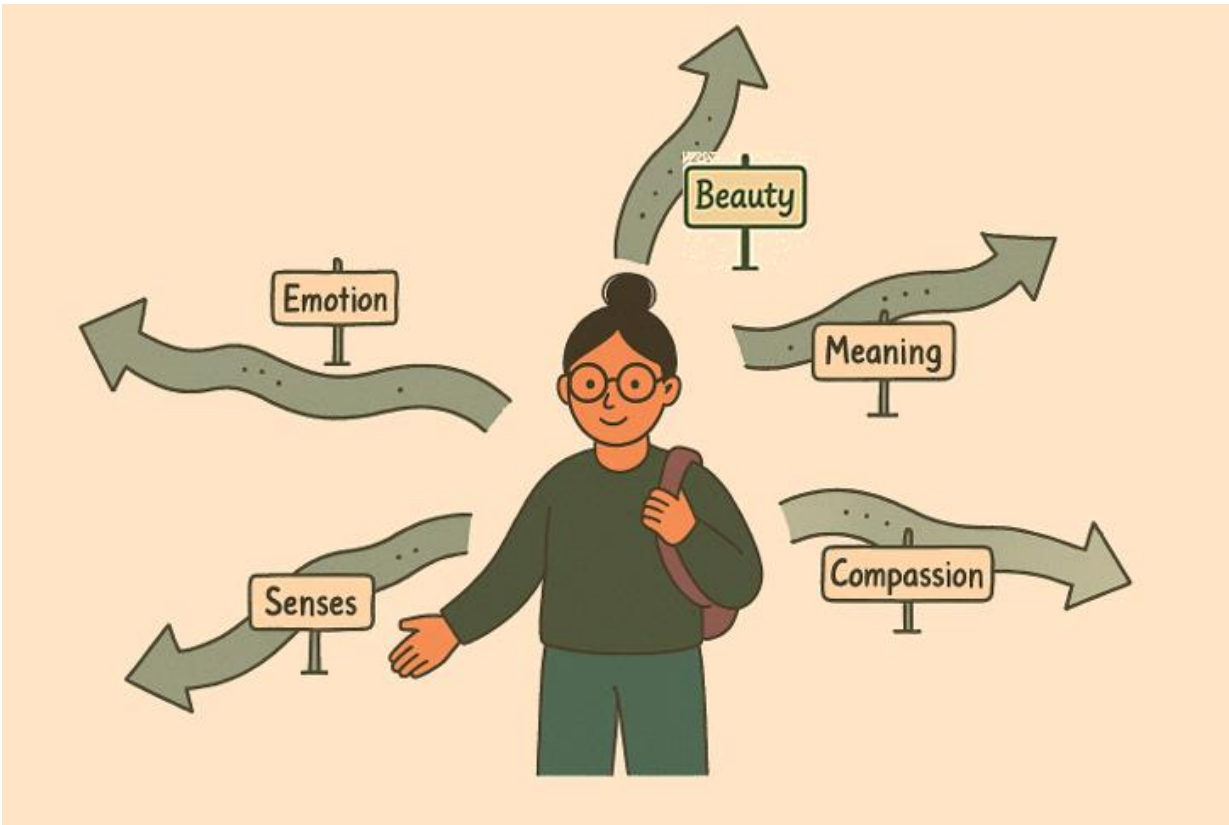


Figure 2. Graphical illustration of the five pathways to nature connection model. Based on (National Trust, 2021).

Key insights

In summary, research on children's nature experiences and connectedness yields key insights that address fundamental questions in the field of nature education:

1. How do children experience nature?

- For children nature is not an abstract phenomenon but a lived experience.
- Children experience nature through active engagement with all their senses and physical capacities.
- A certain level of anxiety is required for peak experiences with nature, but the level needs to align with a child's entry level of mental and physical skills.

2. What is nature connectedness and how can it be measured?

- Nature connectedness in children relates to emotional attraction and affiliation with nature and cognitive understanding of human–nature interdependence.
- There are several measures available for measuring children's nature connectedness, mostly aimed at older children who are able to answer questions about their relationship with nature.
- General knowledge about nature and (intention) to engage in pro-environmental behaviour are not included in the concept of connectedness but treated as separate aspects of the human-nature relationship.

3. Which factors contribute to children's connectedness to nature?

- Nature connectedness decreases with age during primary school, with higher levels of connectedness in younger than in older groups.
- Levels of nature connectedness differ between boys and girls, with most studies showing higher connectedness in girls than in boys.
- Children with more access and experience in nature and children with parents that are more nature-oriented express higher levels of nature connectedness.

4. What are the benefits of being connected to nature?

- Connecting to nature brings immediate positive effects on children's wellbeing including a reduction of stress, improved mood, absence of anxiety, and self-satisfaction.
- The benefits of connecting to nature in childhood last throughout the lifespan, with adults who are more connected showing higher levels of happiness, meaningfulness, vitality in adulthood.

- In adults, this connection to nature also translates into more pro-environmental behaviour, suggesting a potential "happy path to sustainability" founded on fostering children's affinity with nature

5. How do children connect to nature?

- Children connect to nature through multiple pathways. Five basic pathways have been proposed: contact, emotion, meaning, compassion, and beauty.
- Active engagement with nature is crucial, mere access and passive exposure to nature is not sufficient to form a bond with nature
- Little is known on the critical competencies required for successfully establishing a connection with nature via different pathways.



Nature Intelligence in Schoolchildren

Nurturing children's connection to nature

Children face many barriers that hinder the establishment of a human-nature relationship, such as innate or culturally transmitted fears, societal norms, and the appeal of the internet and social media. It is vital for children to overcome these obstacles and build competencies connect to nature.

The predominant focus in nature connectedness research has centred on measuring children's levels of connectedness to nature and elucidating the associated advantages. Little attention has been directed toward understanding the competencies essential for making this connection. Establishing clear benchmarks and expectations for competencies within different pathways not only guides students in their learning journey but also enable educators to design more effective curricula tailored to children's competencies in different domains. In this chapter we present a competency model for children to connect to nature inspired by the concept of Nature Intelligence.

Nature Intelligence

The concept of Nature Intelligence (or NQ) provides a starting point for defining the competencies for children to connect to nature. The concept comprises a multidimensional set of human competencies to connect to nature in a cognitive, emotional and spiritual manner, as well as competencies to actively use the connection with nature to support one own's wellbeing and the wellbeing of the planet (Van den Berg & Albers, 2022), see Figure 3 for a graphical illustration.

This concept was developed in a previous European project, specifically designed to empower youth workers in facilitating connections between young people aged 16-30 and the natural world. This age group, which is commonly known as the Gen-Z generation, stands out by their high interest in sustainability and planetary stewardship. For example, a large-scale survey in the USA showed that 67% of Gen-Z respondents agreed that "climate change should be a top priority to ensure a sustainable planet for future generations", against 57% of boomer



Figure 3. The NQ flower model for young people

and older generations (Tyson, Kennedy, & Funk, 2021). By tapping into this motivation, the NQ concept views competencies that enhance one's connection to nature as a pathway to contribute significantly to a healthier planet, fostering a harmonious relationship between humanity and the environment.

The NQ concept comes with a self-test consisting of 36 statements (3 for each competency) that can be more or less applicable. With this test, each individual can check his or her own a unique 'spider web' profile when it comes to their connectedness to nature, with different levels for each of the twelve competencies. Learning about these profiles can support young people and youth workers to identify which domains and competencies are most developed and where there is still space for growth. It can also be used to develop personal learning goals and for evaluating the effectiveness of interventions and activities to strengthen competencies to connect to nature.

Adapting the concept

Starting from this initial conceptualisation, we sought to adapt the concept of Nature Intelligence to make it suitable for children in the school age. In doing so, we took a holistic approach, using theoretical insights from the literature on children's nature experience and nature connectedness as well as practical insights from nature educators and school teachers in our partnership who work with children in the school age. The latter insights were obtained through structured focus group discussions as well as more informal discussions.

From the literature review we derived the key insight that an NQ model for schoolchildren should include competencies to affiliate with nature and to understand the interdependence of humans and nature as two core dimensions of connectedness to nature. Competencies to actively apply this bond for improving one's own health and the health of the planet are less applicable in this young age group.

Nature educators and teachers agreed with a focus on affiliation and understanding. However, they emphasized the importance of embodied, 'hands-on' skills such as touching the earth with bare hands, making a fire, building a hut, or climbing a tree are crucial. At this age, this also includes pushing boundaries and daring to do and embrace things that may initially seem a bit scary, dirty, or uncomfortable.

Nature educators and teachers saw much use in the availability of a test to gain insight into children’s individual NQ profiles. However, they indicated that the test should be concise and child-friendly. They also expressed that it would be helpful if the test could generate NQ profiles for each child.

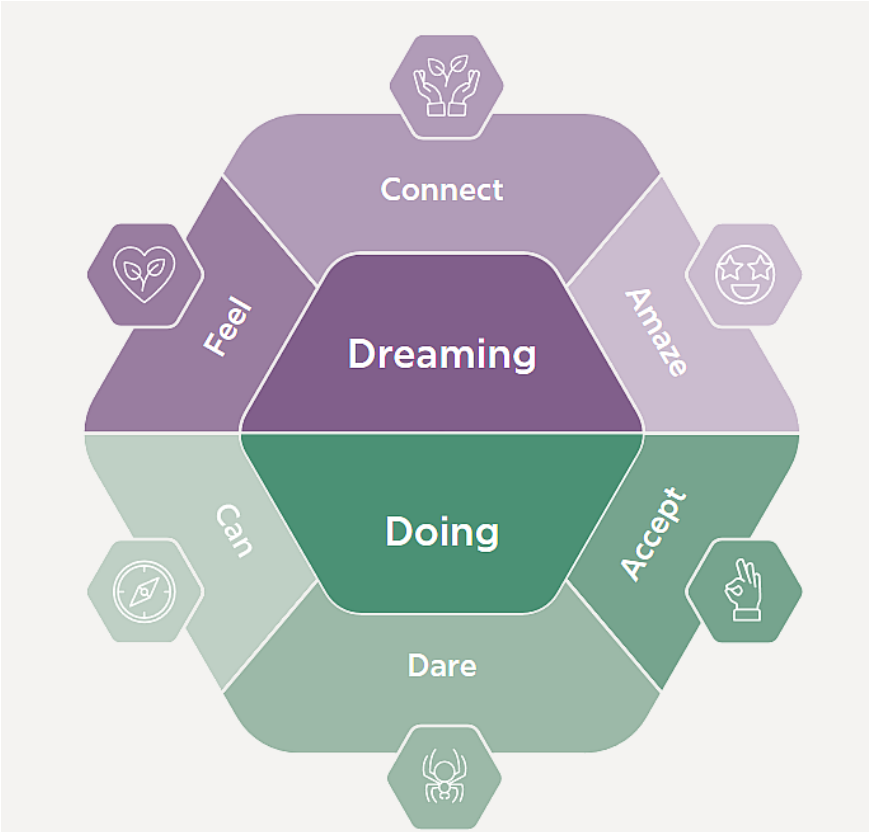


Figure 4. The NQ child model

Dreaming and Doing

Based on both the theoretical and practical insights, we opted to go back to the basics and create a fully revised NQ model for schoolchildren, with different dimensions and competencies. To maintain a link with the initial model and test, we carried out exploratory statistical analyses on an extensive dataset consisting of responses from 276 participants aged 16-30 who completed the original NQ test. A factor analysis of 6 clusters of items relevant for schoolchildren yielded a readily interpretable distinction into two factors, or dimensions. The two dimensions indicated by the statistical analyses suggest two types of pathways for schoolchildren to connect with nature, which we labelled as 'Dreaming' and 'Doing'. The model is illustrated in Figure 4.

Children who connect by dreaming about nature are emotionally engaged with nature, often through social media, by empathising and thinking about it a lot in an involved and emotional way. Children who connect by doing things in nature engage with nature in a more behavioural way, through direct hands-on experiences.

In the NQ-child model, dreaming is represented by competencies to feel, connect and amaze. Doing is represented by competencies to can, dare and accept. Table 3 gives a brief description of each of the competencies.



Dreaming	
	Feel Being able to enjoy nature and experiencing its positive effect on your mind and body.
	Connect Having abilities to connect with nature, to live in harmony and balance with nature, and to identify yourself as part of nature.
	Amaze Realizing the greatness of nature with the associated feelings of smallness and insignificance.
Doing	
	Accept Openness to accept less pleasant experiences such as getting wet or having to pee in the bushes.
	Dare Being able to overcome your own fears by doing things that are kind of scary, like letting a spider walk on your hand or looking closely at a dead bird or mouse.
	Can Having skills to cope when you are out in nature, such as finding your way without a phone if you are lost or growing your own vegetables and edible plant.

Table 3. Description of the competencies in the NQ child model.

NQ-profiles

Because the Dreaming and Doing model includes only two dimensions, it is possible to distinguish among a limited set of four profiles of children with high and low scores in competencies in each domain: Embracers (high scores on competencies of both dreaming and doing), Engagers (good at doing, but less of a dreamer), Empathisers (good at dreaming, but less of a doer) and Enjoyers (not dreamers and not doers). Figure 5 gives a graphical illustration of the four profiles.





		Dreaming	
		High	Low
Doing	High	Embracer 	Engager 
	Low	Empathiser 	Beginner 

Figure 5. The four NQ child profiles.

Validating the model with field observations

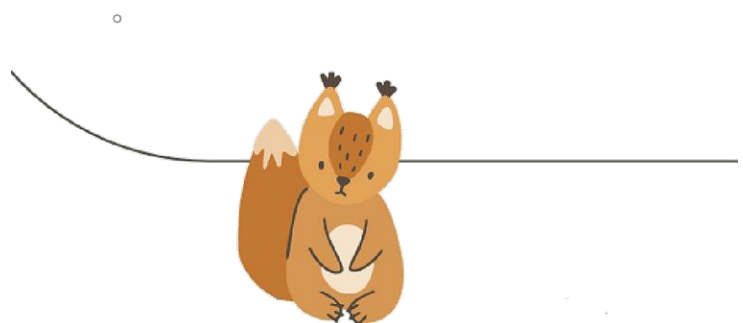
To check the validity of the Dreaming and Doing model all partners were asked to observe and describe a child with a high Nature Intelligence while in nature. The descriptions were structured into two age groups: children at a young age (5-8 years) and children at an older age (8-12 years). The described child could be a known (real) person, or an imaginary character combining several children with high Nature Intelligence. The descriptions could be based on someone they knew, but also be a result of interviews with people working closely with children.

Partners were instructed to write the description as detailed as possible, to include the child's behaviours and choices in the public and private domain, and to describe both innate characteristics (traits) and more fluent capacities (states). The descriptions were written by teachers, educators, or parents. A total of 10 person descriptions were gathered from five different countries: The Netherlands, Germany, Italy, Portugal, and Norway.

The analysis

A thematic analysis was performed on the person descriptions, with codes being assigned to the text. The codes captured competencies related to nature intelligence. Competencies are seen as a combination of skills, attitudes, and knowledge. The codes were pre-determined based on competencies in the NQ-child model. The dreaming dimension had three pre-determined competencies (codes): feel, connect and amaze. The doing dimension had also had three competencies (codes): do, dare and accept. See Table 2.1 in the previous chapter for definitions.

The analysis of the person descriptions showed that all competencies in the dreaming and doing model were re-established in the descriptions of children with a high nature intelligence.



Dreaming



The competency to *feel* was found in relation to expressing a love for nature in words and deeds. It also relates to feeling better and being closer to your true self when being surrounded by nature:

"Frida loves plants as much as animals and has her own flowerbed in the garden as well as a large number of potted plants at home, which she takes care of and sometimes propagates herself." (description of a girl, 12 years, Germany)

"At school, it is noticeable that he suffers from the noise of his classmates, which causes him stress. then he often cries. The perceived pressure sometimes leads to aggressive outbursts and arguments with classmates at school, which we have never observed with him in the forest nursery." (description of a boy, 9 years, Germany)

"(The child, ed.) knows to express who they are. Experiences the space, feels accepted." (description of a child, age group 5-8, the Netherlands)

"In addition, nature is used to look for 'one's own place' appropriate to one's age, preferably less accessible to others and independent." (description of a child, age group 9-12, the Netherlands)

The competency to *connect*, was reflected in descriptions that emphasised children feeling compassion and respect for other creatures:

"He reveals a great sensibility and respect for nature and all living beings." (description of a boy, 7 years, Portugal)

"This child sees the bigger picture and therefore have respect for everything that grows and blossoms." (description of a child, age group 9-12, The Netherlands)

"His most impressive experience was when he caught a small grass snake with his hand in the shallow water between the reeds, just as it was about to devour a frog, thus saving its life." (description of a boy, 9 years, Germany)

The competency to *amaze* especially related to experiencing wonder and awe in nature, especially during magical moments that create life-long memories:

"He takes in the sights and sounds of the forest, marvelling at the towering trees and the chirping of birds." (description of a boy, age group 5-8, Italy)"

"Michele's attitude towards nature is one of respect and awe, and he recognizes the importance of protecting and preserving the environment." (description of a boy, 7 years, Italy)

"Nature-wise child has a lot of imagination, by observing nature, arouses curiosity, allowing them to discover how it works. They see animals in clouds, there are giants walking around, because they recognize giant footprints in the landscape." (description of a child, age group 5-9, the Netherlands)

"She can recall an incredible number of such events, even if they happened several years ago." (description of a girl, 12 years, Germany)

The competency to *amaze* was however often more implicitly present in children's actions than in explicit expressions of awe and wonder:

"His happiness comes from actions and experiences and not really from the spirituality that nature can convey." (description of a boy, 7 years, Portugal)

"Spirituality does not appear to play a significant role in his connection with nature, as his connection is based on a more experiential understanding." (description of a boy, 7 years, Italy)

"Children are caught up in the moment and are not concerned with time. They learn about the seasons, the course of the day and the seasons." (description of a child, age group 8-12, The Netherlands)



Children high in nature intelligence were also described as being observant, which relates to competencies to seeing and understanding processes in nature, such as the change of seasons or differences in lifecycles of plants:

"He can name most of the mammal species living in our regional forests and is very interested in their specific tracks and excretions, which he finds in the forest and tries to classify. For this purpose, he has created an observation book that he uses irregularly during stays in nature to draw findings in it." (description of a boy, 9 years, Germany)

"As he walks deeper into the forest, he begins to observe the different species of plants and animals that make their home in this environment. He can identify the different types of trees, noting the distinctive bark patterns and leaf shapes. He also observes the various birds, noting their unique calls and behaviours." (description of a boy, 12 years, Italy)

Doing

The ability to *do* things in nature was frequently mentioned in the descriptions of children with a high intelligence and was further specified as follows:

"He loves winter most, and often goes on long and craving tours. He loves climbing, skiing, and other craving and more extreme sports, and has learned to evaluate risk in nature. He also developed good outdoor skills and can find his own way with card and compass." (description of a boy, age group 9-12, Norway)

"She is confident in handling fire, can prepare meals outdoors, pitch a tent and much more. Together with two friends, she even managed to light a fire with a fire drill. She is good at assessing dangers such as ice that is too thin." (description of a girl, 12 years, Germany)

"He persistently practised with his friends on our fireplace in the forest nursery to light a campfire and to keep it going, which he succeeded in doing better and better after several failed attempts. He was proud when he cooked noodle soup on it himself." (description of a boy, 9 years, Germany)

The importance of unfiltered interaction with nature, of being playful and creative in nature, was often mentioned as an additional theme. It relates to being playful and eager to explore and experiment in nature, and the love for building things.

"With tools he passionately likes to work and crumble rotten trunks as well as ice floes in winter with great perseverance.... In the summer, he likes to spend hours outdoors experimenting with water." (description of a boy, 9 years, Germany)

"He also loves to play in nature with his friends, or alone, cooking soup, building forts, having sword fights with wood." (description of a boy, 7 years, Norway)

"Something exciting, building a hut from materials you find. have your own place. to which you add things; "this will be the bedroom. Because there are fewer nettles here, here is the kitchen." (description of a child, age group 9-12, the Netherlands)

The competency to *dare* things in nature and benefit from taking risks and overcoming one's fears was frequently mentioned in the descriptions of children with a high nature intelligence:

"(...) The children knew what to do not to worry those horses. So, staying calm and they had to suppress impulses to run away. The one child who was so scared grew from the experience." (description of a child, age group 9-12, the Netherlands)

"Now that he is older and has permission to go out in nature on his own, he has developed the plan to sleep outside the entire year and is halfway now. He still goes on family trips very often, and experiences new things every time. When he is on the trips, he has a lot of responsibility for his younger siblings. He does not always like that, but he does like to learn them new things." (description of a boy, age group 9-12, Norway)

"He also doesn't shy away from more dangerous situations or even provokes them a little by climbing quite daringly in trees and over a bridge he built himself." (description of a boy, 9 years old, Germany)



"He is now 7 years old and able to carry his own bag, that makes him proud but secretly he would love to go without a bag as well as he gets tired much faster now." (description of a boy, 7 years, Norway)

"They had also found a fallen tree and then there was the challenge of who could get over it the fastest." (description of a child, age group 8-12, the Netherlands)

"Huge excitement when the fire was lit." (description of a child, age group 8-12, the Netherlands)

"At the age of 11, she already dared to spend a night in the forest with her friend without a tent and was very enthusiastic about it afterwards." (description of a girl, 12 years, Germany)

"The strolls become longer and the landscape and nature are used to experience the process of autonomy." (description of a boy, 11 years, the Netherlands)

"He also doesn't shy away from more dangerous situations or even provokes them a little by climbing quite daringly in trees and over a bridge he built himself." (description of a boy, 9 years, Germany)

"Huge excitement when the fire was lit." (Child, 10-12 years, the Netherlands)

Last, the competency to accept unpleasant experiences with nature was also mentioned in the descriptions:

"Thinks it is fine to get dirty and accepts that falling and getting up again is part of it." (description of a child, 5-8 years, The Netherlands)

"He is constantly eager to make new physical experiences and also accepts very unpleasant sensations, such as ice-cold hands when he chops ice floes out of the frozen lake or when it rains, he dams up rivulets with sticks and mud to form large puddles." (description of a boy, 9 years, Germany)

The social dimension

Several of the child descriptions mentioned additional social competencies highlighting the importance of the social setting and of sharing values and knowledge with others in a respectful and inspiring manner. These competencies emphasise collaborating with peers and adults, maintaining and appreciating family traditions throughout the seasons, and sharing values and knowledge about nature. For example:

His parents are avid nature enthusiasts and frequently take him on hikes and camping trips, exposing him to different types of flora and fauna. They allow him to explore and learn from his surroundings." (description of a boy, 7 years, Italy)

It is clear, also from the literature review, that children growing up with family and peers who share an interest in nature are more likely to develop a connection with the natural world. However, since children have little choice in who they grow up with, we consider the social context as supportive in making a connection but not a competency that can be changed through working with children. Instead, we choose to focus on individual child competencies.

Conclusion

The Dreaming and Doing model that was developed for the schoolchildren was corroborated by the descriptions of partners of children with a high nature intelligence.



A self-test for older schoolchildren

Based on the dreaming and doing model, we developed an NQ-self test for schoolchildren (age 9-12) who are old enough to answer questions about their relationship with nature themselves. In this chapter we present this self-test along with empirical data on its reliability and validity derived from a sample of 771 Dutch schoolchildren.

The NQ-self test

The NQ-self test was developed by the scientific partners of this project. They initially compiled a long list of 30 items in Dutch, aligned with the competencies of the Dreaming and Doing model. To ensure the items were appropriate for the 9-12 age group, the list was reviewed and refined with input from school teachers and nature educators in the Netherlands. The revised list was then validated through a survey conducted among Dutch schoolchildren. Based on the survey results, a selection of 18 items was made that best reflect the intended competencies. Table 4 provides an overview of the final set of 18 items, translated into English.

Table 4. Items in the self-test for schoolchildren. With response options ranging from 1 not at all applicable to 5 = highly applicable.

DREAMING	
Competency	Statements
Feel	I feel relaxed and free of stress when I am in nature
	I enjoy the smells and the sounds of nature and feeling the wind on my face
	I feel happy when I am in nature
Connect	I love nature very much
	I feel that nature and I belong together
	I see nature as a friend who is always there when I am in need
Amaze	I think nature is one great wonder
	When I look up at the night sky and see the moon and the stars, I feel very tiny, like a little dot in big space
	I feel sorry every time I kill a fly or other insect
DOING	
Competency	Statements
Can	I can grow my own vegetables and edible foods
	I can make a fire with leaves and twigs
	I am able to do things in nature like digging a deep hole or climbing a tree
Dare	I dare to look at a dead bird or mouse from nearby
	I dare to pick up an insect or a worm with my bare hands
	I find it interesting to look at the poop of an animal
Accept	I consider it no problem to go out in the rain and get all wet
	I enjoy walking barefoot in the mud
	I do not feel ashamed when I have to pee behind a tree or bushes

Survey results

The 30-item version of the NQ-self test was administered to a representative sample of 771 children in grades 7 and 8 (ages 9-12) across 39 primary schools in both urban and rural areas of the Netherlands. The children completed the test in their classrooms, either online using tablets or offline with a printed booklet. In this section, we summarise the main results of the survey, focusing on the final selection of 18 items included in Table 4. A more detailed report of the results from the Dutch survey, including the full 30-item version of the test, can be found in Van den Berg (2023).

Validity

The 18-item version of the test (with complete data for 749 children) demonstrates good construct validity. Table 5 presents the results of a confirmatory factor analysis with varimax rotation, based on the mean scores for the six competencies. The six competencies align clearly with the two dimensions, and the explained variance is high (67%). This indicates that the scale accurately reflects the theoretical constructs of Dreaming and Doing that it was designed to measure. The reliability of each of the two scales is also high, with a Cronbach's alpha of .86 for the 9 items in the Dreaming dimension and .80 for the 9 items in the Doing dimension.

Table 5. Results of factor analysis

Competency	Factor 1 Dreaming	Factor 2 Doing
Feel	.80	
Connect	.82	
Amaze	.70	
Can		.66
Dare		.61
Accept		.70
<i>Explained variance</i>	31%	36%
<i>Cronbach's Alpha</i>	.86	.80

The overall scores on the NQ-self test show a moderately strong correlation, $r = .67$, with overall scores on the Inclusion of Nature in Self measure for connectedness to nature (Kleespies et al., 2021). This measure was included to gain insight into how the test relates to other established measures of nature connectedness. The moderately strong correlation suggests that the test has good external validity, as it demonstrates a meaningful relationship with a relevant external measure.

Mean scores

As shown in the first column of Table 6 below, the 749 children in the Dutch sample scored an average of 60 points on the NQ Self-test (with scores ranging from 18 to 90). This indicates that, on average, children score just above the midpoint of 54, suggesting a moderate but not strong level of Nature Intelligence. Sum scores on the two dimensions of Dreaming (*Mean* = 30) and Doing (*Mean* = 30) were also above the midpoint and comparable, indicating fairly balanced competencies in both areas.

Looking more specifically at the competencies in the sample as a whole, children in general report feeling relaxed and connected in nature, but score somewhat lower on Amaze – the ability to experience wonder and awe. Nature seems to be valued mainly as a pleasant space, rather than a source of deep reflection or mystery.

On the Doing side, children in general feel reasonably confident when it comes to Doing things in nature, such as building something or handling insects. However, their confidence drops significantly when it comes to accepting discomforts – such as getting wet or having to pee in the bushes. This points to a possible lack of tolerance for physical inconvenience, perhaps due to overprotection or a lack of unstructured, messy outdoor play.

Table 6. Mean sum scores for each NQ competency, dimension, and overall test scores for the total sample and the four profile groups in the Dutch sample (reference midpoints in parentheses, scores rounded to the nearest whole number).

Dimension	Competency (midpoint)	Overall mean N = 749	Beginner N = 263	Engager N = 118	Empathiser N = 125	Embracer N = 243
Dreaming	Feel (9)	11	9	10	13	14
	Connect (9)	10	7	8	11	12
	Amaze (9)	9	7	8	11	11
	Total (27)	30	23	26	35	37
Doing	Can (9)	11	9	12	10	13
	Dare (9)	11	9	12	9	13
	Accept (9)	8	6	10	7	11
	Total (27)	30	24	34	26	37
	NQ score (54)	60	47	60	61	74

Taken together, the results for the representative Dutch sample as a whole indicate that children’s connection with nature is primarily affective and active: they feel

positively about nature and enjoy engaging in activities, but are less attuned to its deeper, spiritual dimensions and find it challenging to accept discomforts.

Profile groups and their competencies

Based on cut-off points for the sum scores on the dimensions of Dreaming and Doing — either above or below the mean sum score of 30 (on a scale from 9 to 45) — about 35% of children fall into the group of Beginners, with low scores on both Dreaming and Doing. About 32% are classified as Embracers, with high scores on both dimensions. Roughly 17% are Empathisers, with high scores on Dreaming but low scores on Doing, while 16% are Engagers, with the opposite pattern: high Doing scores but lower scores on Dreaming. (See Table 6 for sum scores per profile group.)

While all competencies contribute to the profiles, three stand out. On the Dreaming side, the strongest differences between Beginners and Embracers are found in Connect — feeling emotionally close to nature — and Feel — enjoying nature and experience positive effects. On the Doing side, the largest gap between Beginners and Embracers appears in Accept — the ability to tolerate discomforts such as rain or mud. These three competencies seem to play a particularly important role in shaping a strong NQ profile.

Profile groups and their characteristics

As shown in Figure 6, the four NQ profiles differ in their scores on the Inclusion of Self in Nature test for connectedness with nature, with beginners showing the lowest levels of connectedness and embracers showing the highest levels.

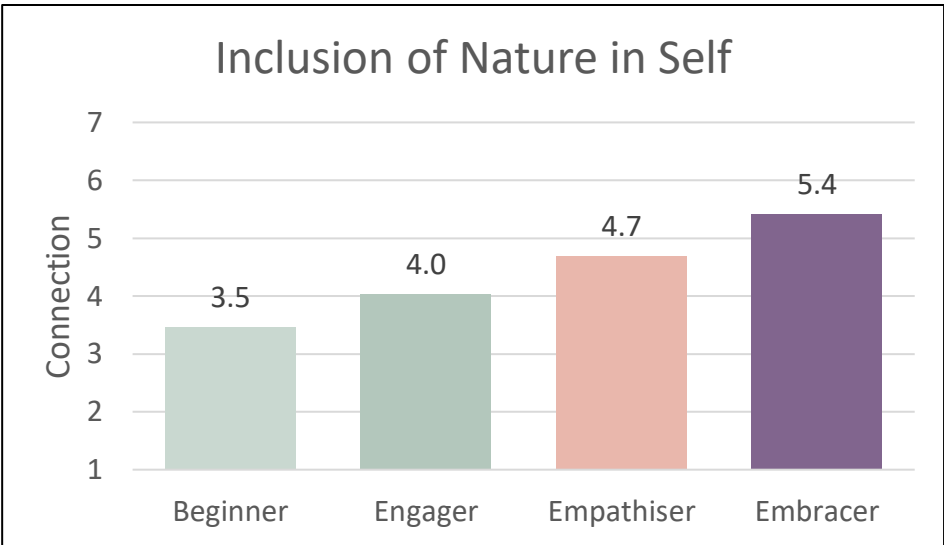


Figure 6. Mean scores on the Inclusion of Nature in Sel-test in each of the four NQ profiles (range 1-7).

The four NQ-profile groups also differ in background characteristics. As illustrated in Figure 7, girls are overrepresented in the profile of Empathisers, and underrepresented in the profile of Engagers. Empathisers and Embracers more often have parents who regularly or frequently take them out into nature than Engagers and Beginners. Levels of nature education in school are generally low, but Beginners tend to get even less lessons in nature education. Although nature lessons at school appear to have only a modest effect, they may help Beginners take a first step toward becoming more connected to nature. For most children, however, the strongest predictor of Nature Intelligence is not what happens at school, but what happens at home: especially whether parents actively take them outdoors.

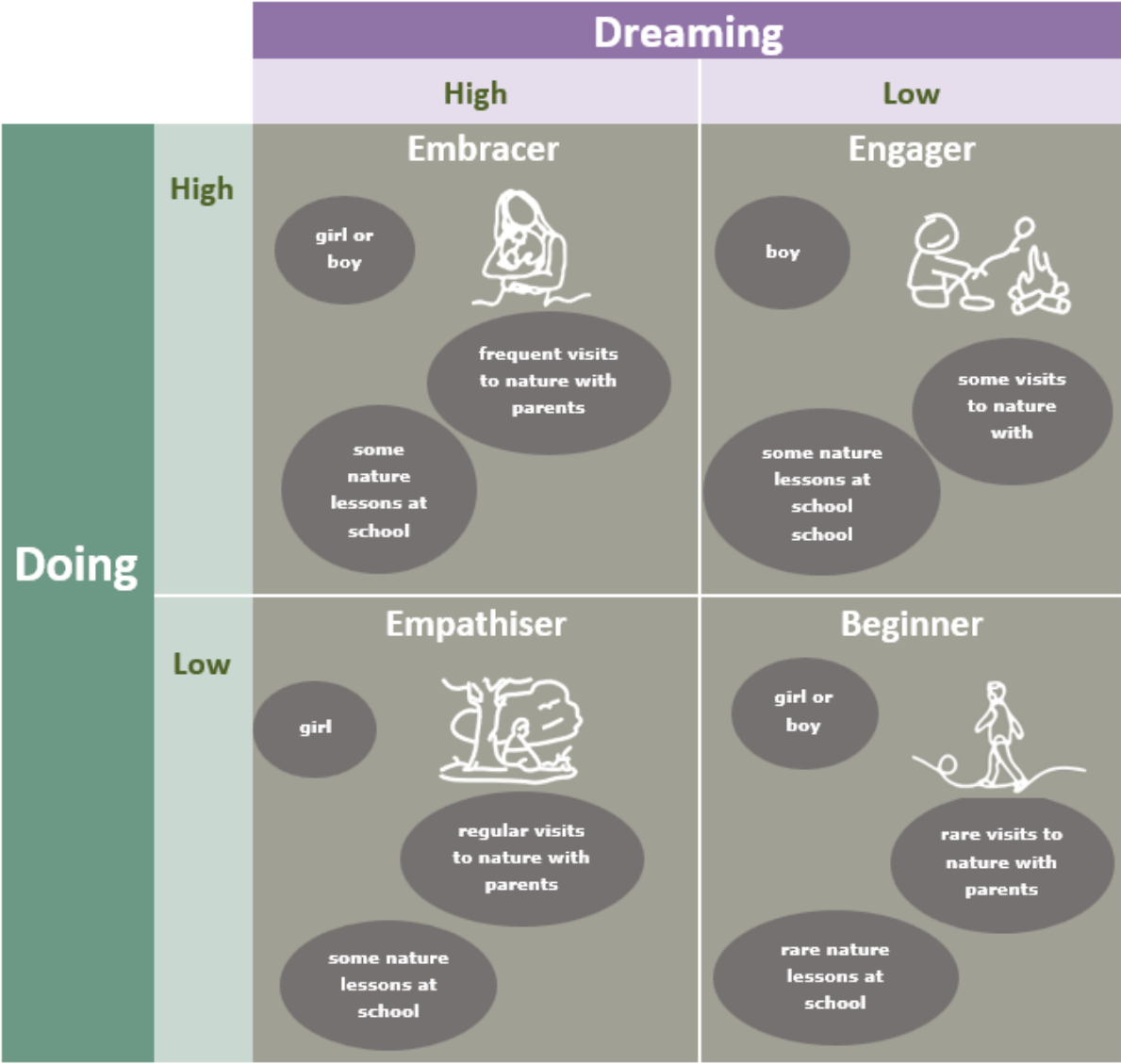
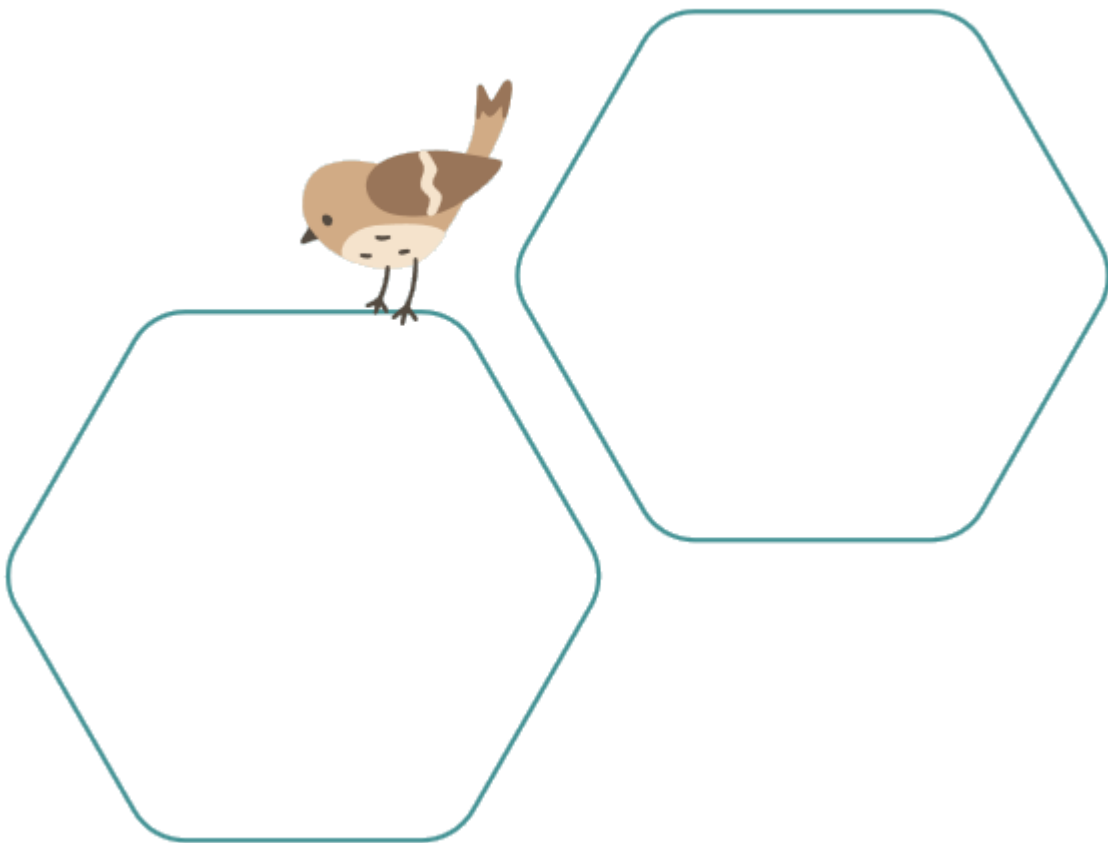


Figure 7. Background characteristics of children with different NQ profiles.

Conclusions

The results of a survey among a representative sample of schoolchildren show good validity and reliability of a child-friendly NQ-test that discriminates between three competencies to connect to nature by Doing, and three competencies to connect to nature by Dreaming.

The results also show discriminatory power of the test to distinguish between different NQ-profiles, with different background characteristics. Insight into these profiles provides guidelines for nature educators on how to strengthen schoolchildren's nature connectedness.



An adult-assessed test for young children

This chapter presents an adult-assessed version of the Dreaming and Doing test for young schoolchildren (5–8 years) who cannot yet answer questions about their relationship with nature themselves. The test was developed collaboratively within the Erasmus+ partnership.

The NQ adult-assessed test

The self-test for older children served as a starting point for developing this adult-assessed version. The items were reviewed and adapted during an in-person focus group with partners experienced in working with younger children. The goal was to retain the original meaning while making the wording age-appropriate. The final test consists of 18 items, aligned with the six competencies of the Dreaming and Doing model. Adults who know the child well — such as parents or educators — rate how applicable each statement is to the child. Table 7 provides an overview of the items, translated into English.

Table 7. Items in the adult-assessed test for schoolchildren, with response options ranging from 1 = not at all applicable to 5 = highly applicable (scores scaled from the original 7-point scale).

DREAMING	
Competency	Statements
Feel	Being in nature makes This child peaceful.
	This child enjoys feeling the grass, the wind and the water on its skin
	This child feels happy in nature
Connect	This child loves nature very much
	This child feels sad and distressed when animals are hurt or pass away
	Out in nature this child always looks out for hidden animals like insects, frogs, birds or fishes
Amaze	This child asks questions about the mysteries of nature
	This child is aware that humans are part of nature
	This child would rather not kill a fly or other insect
DOING	
Competency	Statements
Can	This child likes to garden and grow plants
	This child is keen on learning skills like making a fire or building a tree-hut
	This child is able to do things in nature like digging a deep hole or climbing a tree
Dare	This child is not afraid to look at a dead bird or mouse from nearby
	This child dares to let a bug or an ant run across its hand

	This child finds it interesting to look at the poop of an animal
Accept	This child considers it no problem to go out in the rain and get all wet
	This child is the type of kid who enjoys walking barefoot in the mud
	This child does not feel ashamed to pee behind a tree or bushes

Survey results

The adult-assessed version of the Dreaming and Doing test was translated into four languages of the partners countries (Italian, Portuguese, German and Dutch) and then distributed (either as an online survey or as a paper-and-pencil test) by the partners in these countries. A total of 80 complete questionnaires were collected. Table 7 gives an overview of the response in the four countries.

Table 7. Results of factor analysis

Competency	Italy	Portugal	Germany	Netherlands	Total
No. of children	15	30	23	12	80
% boys	60%	57%	52%	67%	58%
Mean age	7	7	7	7	7
Age group (no. of children)					
5 years	0	0	0	5	5
6 years	5	8	5	0	18
7 years	5	12	11	3	31
8 years	5	10	7	4	26
role of adult					
parent/caregiver	0	30	20	3	53
teacher	15	0	3	7	25
nature educator	0	0	0	2	2

The total sample of 80 children shows a distribution across ages from 5 to 8 years, with a mean age of 7. Boys are slightly overrepresented overall (58%), especially in the Netherlands (67%). Only 6% of the children were 5 years old, all from the Netherlands, indicating that the youngest age group is underrepresented.

There are notable country differences in who administered the test. In Portugal, all assessments were completed by parents or caregivers, whereas in Italy, they were all completed by teachers. Germany and the Netherlands show a mix, with the Netherlands being the only country where nature educators were involved (2 cases).

These results suggest variation across countries in who participated and under what conditions. This likely reflects practical and contextual factors rather than inherent national differences, and should be kept in mind when interpreting cross-country comparisons.

Validity

Table 8 presents the results of a confirmatory factor analysis with varimax rotation, based on the mean scores for the six competencies. While the same two-factor solution emerges in the younger age group, the structure is less clearly defined. The distinction between the Dreaming and Doing dimensions appears less pronounced, with Feel and Can showing notable cross-loadings. This suggests a more integrated experiential-actional dimension in younger children, where emotional engagement and the sense of agency are not yet clearly differentiated

The explained variance is high (67%). This indicates that the scale accurately reflects the theoretical constructs of Dreaming and Doing that it was designed to measure. The reliability of each of the two scales is also high, with a Cronbach's alpha of .80 for the 9 items in the Dreaming dimension and .78 for the 9 items in the Doing dimension.

Table 8. Results of factor analysis

Competency	Factor 1 Dreaming	Factor 2 Doing
Feel	.86	.48
Connect	.83	
Amaze	.84	
Can	.56	.49
Dare		.72
Accept		.87
<i>Explained variance</i>	38%	30%
<i>Cronbach's Alpha</i>	.80	.78

The overall scores on the adult assessed Dreaming and Doing test show a moderately strong correlation, $r = .55$, with overall scores on the Subjective Happiness scale (Lyubomirsky & Lepper, 1999). This measure was included in the survey to gain insight into how well the test predicts children's wellbeing. Subjective well-being was more strongly correlated with Dreaming, $r = .55$, than with Doing, $r = .46$. These results suggest that emotional engagement with nature (Dreaming) is more strongly linked to children's happiness than hands-on interaction (Doing), providing initial support for the predictive validity of the test in relation to subjective well-being.

Mean scores

As shown in Table 9 (column 'Overall mean'), the 80 children assessed by an adult in the four partner countries scored an average of 74 points on the NQ Self-test

(range 18–90). This is well above the midpoint of 54, indicating a strong overall level of NQ.

Table 9. Mean sum scores for each NQ competency, dimension, and overall test scores for the total sample and the four profile groups in the young child sample (reference midpoints in parentheses, scores rounded to the nearest whole number).

Dimension	Competency (midpoint)	Overall mean <i>N</i> = 80	Beginner <i>N</i> = 19	Engager <i>N</i> = 4	Empathiser <i>N</i> = 19	Embracer <i>N</i> = 38
Dreaming	Feel (9)	12	10	13	14	14
	Connect (9)	12	9	11	13	14
	Amaze (9)	12	10	10	13	13
	Total (27)	36	29	34	40	41
Doing	Can (9)	13	11	12	11	14
	Dare (9)	13	11	14	10	13
	Accept (9)	12	10	13	10	14
	Total (27)	38	32	39	31	41
	NQ score (54)	74	61	73	71	81

The overall mean sum scores across the six competencies show a high and relatively balanced profile. Sum scores on both Dreaming (*Mean* = 36) and Doing (*Mean* = 38) dimensions are clearly above the midpoint, suggesting that young children are perceived as both emotionally and actively engaged with nature. All individual competency scores exceed the reference midpoint of 9, pointing to a broad and consistent expression of Nature Intelligence in early childhood.

Compared to the older children (Table 6), the younger children had a notably higher total NQ score of 74 versus 60. While the older group shows clear differentiation between the competencies, the younger group presents a more consistently high profile. Especially the Accept competency, which scored relatively low in the older group reaches nearly the same level as other competencies in the younger group.

These findings suggest that Nature Intelligence, as perceived by adults who know the child well, may be more strongly expressed in early childhood. This may partly reflect a somewhat biased selection of children, as the participating partners who collected the data were actively involved in nature education, which could have influenced how they selected and observed children’s nature-related behaviours.

Profile groups and their competencies

Based on cut-off points for the mean sum scores on the dimensions of Dreaming and Doing — either above or below the average mean sum score of 37 (on a scale from 9 to 45) — about 24% of children fall into the group of Beginners, with low scores on both Dreaming and Doing. About 48% are classified as Embracers, with high scores on both dimensions. Roughly 24% are Empathisers, with high scores on Dreaming but low scores on Doing, while only 5% are Engagers, with the opposite pattern: high Doing scores but lower scores on Dreaming.

As shown in Table 9, the competency profiles of the four groups show clear distinctions. Beginners score low across all six competencies, especially on Connect and Accept, suggesting limited emotional connection and a cautious attitude towards nature. Engagers show relatively high Doing scores — particularly on Dare — but lower scores on Dreaming, indicating a more action-driven but less emotionally resonant engagement. Empathisers, in contrast, score high on Dreaming competencies such as Feel, but lower on Doing, suggesting that they are deeply affected by nature but less inclined to act on that engagement. Embracers score high across all six competencies, with strong scores on both emotional and action-oriented dimensions, representing a well-rounded and fully engaged profile of Nature Intelligence.

Differences between countries

Figure 8 provides a visual summary of some notable differences between the four participating countries on key indicators: the average scores on the Dreaming and Doing dimensions of Nature Intelligence, the percentage of children classified as Beginners, and the percentage rated as 'very happy' on the Subjective Happiness Scale. The overall pattern suggests that, while children in all countries are perceived as relatively engaged with nature, there are notable differences in how their engagement and well-being are assessed.

The figure shows clear differences between the four countries in average Dreaming and Doing scores, the proportion of children classified as Beginners, and how happy children were rated. Children in Italy scored lowest on Doing and had the highest number of Beginners. They were also rated least often as very happy. In Portugal, Dreaming scores were highest, with few Beginners and many children seen as very happy. Germany showed high scores on both Dreaming and Doing, with a moderate number of Beginners and lower happiness ratings. In the Netherlands, Doing was relatively high, with few Beginners and relatively high happiness scores.

These differences likely reflect not only children's actual experiences, but also who completed the ratings. In Portugal and Germany, most ratings were done by parents

or caregivers, who may observe children in a broader range of settings. In Italy, all ratings came from teachers, who mainly see the children in a classroom context — possibly underestimating how happy or engaged they are in other situations. In the Netherlands, the group of assessors was more mixed, including teachers, caregivers and nature educators.

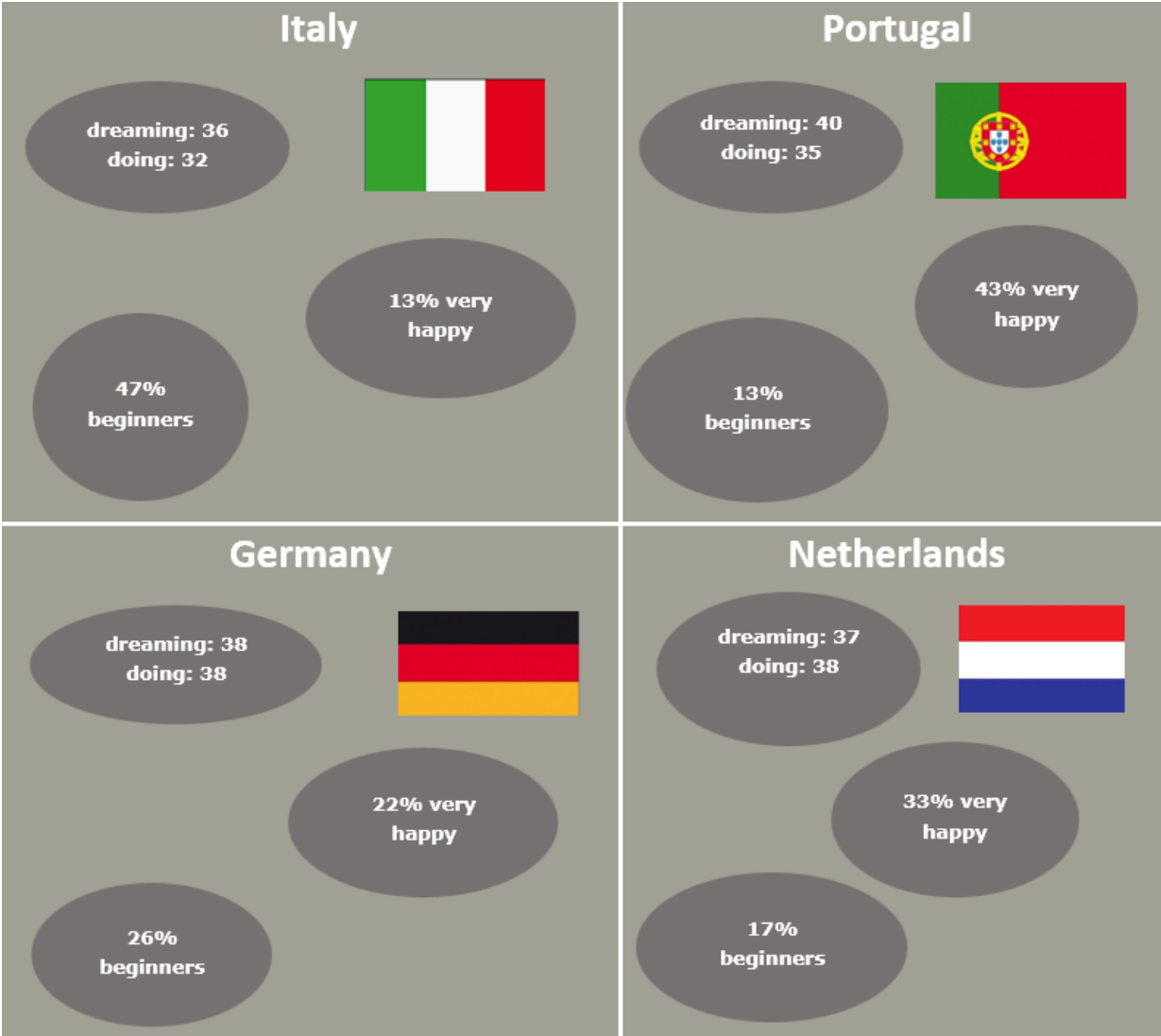


Figure 8. Country profiles.

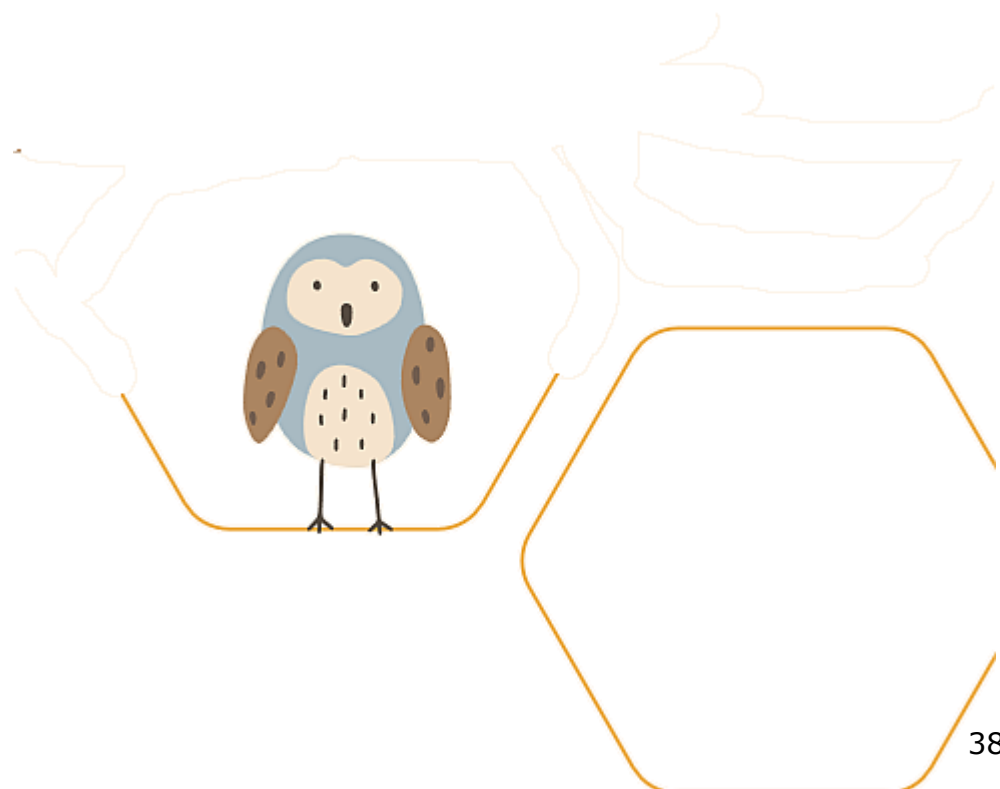
Conclusions

The results from the adult-assessed Nature Intelligence (NQ) test for younger schoolchildren provide further support for the validity and internal consistency of the Dreaming and Doing model. Children in this age group are perceived by adults who know them well as highly engaged with nature, both emotionally and behaviourally, with consistently high scores across all competencies. The two-factor structure of the model holds, though the dimensions are more interwoven than in older children—particularly in the overlap between emotional engagement (Feel) and action-based competencies (Can).

The test also distinguishes well between different NQ profile types, offering valuable insights into how individual children connect to nature. A large proportion of children were classified as Embracers, suggesting that young children may naturally express a broad and balanced form of Nature Intelligence—although this may also reflect idealised perceptions by adults.

Country differences in scores and profiles should be interpreted with caution. Variations are likely influenced by differences in who completed the assessments and the contexts in which they observed the children. This underscores the importance of considering contextual factors when using the test in practice.

Taken together, these findings support the use of the adult-assessed Dreaming and Doing test as a valid and meaningful tool for assessing young children’s nature-related competencies in educational and caregiving settings.



Conclusions and insights

This report presents a model and tests for understanding and measuring Nature Intelligence (NQ) in school children aged 5 to 12. The concept of NQ was first developed in a previous European project, aimed at supporting youth workers in facilitating nature-related competencies in young people aged 16 to 30. Based on a literature review, practical insights from nature educators and teachers, and field observations, we developed a child version of the model that is developmentally appropriate but conceptually aligned with the original youth framework.

The result is a two-dimensional NQ-model that distinguishes between six specific competencies through which children connect with the natural world: Feel, Connect, Amaze (grouped under the dimension of Dreaming), and Can, Dare, Accept (under the dimension of Doing). This 'Dreaming and Doing' model enables individual and group profiling across four types — Beginner, Engager, Empathiser, and Embracer — each reflecting a different combination of Dreaming and Doing competencies to connect to nature.

The model was validated in two age groups: older children (8–12 years), who completed a self-test, and younger children (5–8 years), for whom an adult-assessed version was developed. In both groups, the Dreaming and Doing dimensions proved reliable and interpretable. The model also proved useful in differentiating between children with distinct NQ-profiles - Beginners, Engagers, Empathisers, and Embracers - each characterised by different combinations of emotional and action-based competencies. These profiles offer practical guidance for developing more personalised and effective nature-based pedagogies.

In both age groups, children were generally perceived as strongly engaged with nature. Younger children scored especially high across all competencies, suggesting either a developmental sensitivity or a tendency among adults to perceive nature-related behaviours in early childhood more positively. In the older group, competencies were more differentiated, with some children showing reluctance towards discomfort in nature or lower emotional resonance. This pattern suggests that children's connection to nature may diminish with age unless it is actively sustained. The findings highlight the importance of nature education and meaningful experiences in countering this trend and supporting the continued development of nature-related competencies throughout childhood.

We observed differences in NQ scores between the four partner countries (Italy, Portugal, Germany, and the Netherlands) in the test for young children. These differences are likely influenced by contextual factors such as who completed the

assessments (teachers, parents, or nature educators), and the situations in which children were observed (e.g., classroom settings versus outdoor environments). They may also reflect broader cultural attitudes toward childhood, nature, or educational practices. This highlights the importance of contextual awareness when applying the test in practice and cautions against interpreting national differences as inherent to the children themselves.

What we learned

The value of the concept of Nature Intelligence, and of the Dreaming and Doing model for schoolchildren lies in what it enables: a more explicit understanding of how children relate to nature, and how this relationship can be supported in practice. It provides a language for something that is often sensed but rarely articulated—both by adults and by children themselves.

By making children's nature-related competencies visible—emotionally and in action—it opens up new ways to reflect, respond and engage. The model offers a shared vocabulary that helps educators, caregivers and children talk about how they feel, act, and grow in relation to the natural world. This can support self-awareness in children, but also help adults recognise, validate and strengthen the many different ways in which Nature Intelligence is expressed.

The test instruments developed alongside the model allow these competencies to be made tangible. They do not measure fixed traits, but reveal patterns that might otherwise remain unnoticed. Rather than offering a diagnosis, they provide a starting point for conversation and reflection—about variation between children, within groups, and across contexts.

The model also reminds us of the importance of starting early. Young children often show a spontaneous openness toward nature, which can be nurtured and sustained when adults offer time, space and gentle guidance. Involving families and caregivers in this process is essential, as the home environment plays a key role in shaping how children grow up with—or away from—nature.

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