Nature as Co-teacher

The supportive function of nature for early childhood language education.

Jannette Prins

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Voor mijn moeder, die me leerde
dat je het paradijs kunt vinden in Drenthe

Colofon

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NATURE AS CO-TEACHER

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General introduction

Mij spreekt de blomme een tale
Mij is het kruid beleefd
Mij groet het altemale
Dat God geschapen heeft

(Guido Gezelle)

To me the flower tells her story
To me the herb has been polite
To me all nature sings her glory
All that God has brought to light

(translation: J. Prins)

This dissertation is focused on the supportive function of nature for children's language development in early childhood education. Can flowers speak or herbs be polite? In the poem, the poet Guido Gezelle (1860) attributed linguistic quality to nature. However, not only poets sense the linguistic quality of nature and Dennis' story illustrates this as well:

> *Dennis is a three-year-old, who attends preschool for three days a week. Each day he and his classmates spend an hour outdoors, playing on the playground of the school. The playground has nice equipment, including a bird nest swing, a slide and a climbing structure, offering all kinds of play affordances. Most of the time the teacher also brings out the bikes, giving the children even more play opportunities. On some days the teacher chooses to go to the green nook of the playground. It is a smaller area with a woodchip floor, small trees and shrubs and a small bush tunnel. Dennis prefers playing outdoors over playing in the classroom. Outdoors he can let off steam, releasing energy. And releasing energy he does; he is running around the playground. Surprisingly, he does not touch any of the play sets and he is screaming so loudly that his teacher and classmates often ask him to be quiet. The sound of his voice is reflected by the concrete tiles and the walls that surround the playground. However, in this hollering he does not speak any word. The next day Dennis and his classmates go to the small green nook of the playground. Dennis sneaks through the bush tunnel, again and again. He looks around, walks carefully, and speaks with a soft voice. He's guiding his steps with some words: 'what's this, I walk through, walk through, wow this is scary.' Going underneath a hawthorn bush, he speaks to the hawthorn berries: 'Oh look, there, there you are strawberries.' He picks some of the berries, shows them to a classmate, and says: 'these are for the bird, I think the birds like them, like them, mmmmmjam the birds.'*

Rationale for the current dissertation

The story of Dennis shows how two different play environments create (almost) two different children: one totally overwhelmed by the schoolyard's sounds and affordances, screaming with a raw voice not using a single word, and one whose attention is drawn by the green surroundings and its affordances, talking softly to himself and his friends and to nature, while exploring the environment and asking questions about his findings. This striking observation raises the question: can nature support language development in early childhood education?

From Garden to KFC in early childhood education

Early childhood education (ECE) has a long and standing tradition of playing outside, preferably in places with plants, trees and shrubs. For instance, Friedrich Froebel (1782–1852) plotted the word 'Kindergarten' as a name for the place where young children should be educated. Kindergarten was on the one (metaphorical) hand a garden *of* children, where children, like flowers, can unfold and grow. But on the other hand it suggested that a garden *for* children should be part of early educational experiences (Brown & Kaye, 2017; Bruce et al., 2019). The garden should be a place for rich sensory experiences, full of stimulating characteristics to explore, and to meet through active exploration, play, and talk. In the garden as part of Froebel's kindergarten, children owned a small individual garden, where they were free to sow and plant what they wanted, but where they also had a shared responsibility for the communal garden. At the center of Froebel's Kindergarten pedagogy were freedom for self-initiated exploration of the garden to have firsthand meaningful experiences, together with responsibility for the shared garden (Aslanian et al., 2023; Tovey, 2012). However, the gardens as a place for self-initiated play in ECE, have fallen into decline.

Since most children now live in highly urbanized cities, opportunities for outdoor play in nature, in ECE as well as around the home, have decreased (Colding et al., 2020). There has been a global concern about the time young children spend outdoors, due to urbanization, increased screen time, and parental safety concerns (Ng et al., 2014). Moreover, the concerns are not only about the time children spend outdoors, but also about the quality of the space in cities that is left for children to play. Spaces around schools and homes are getting more and more designed according to the principle of KFC: Kit Fence Carpet (Woolley, 2007). These 'child-friendly' spaces usually have a climbing structure, sometimes a sand pit, a safe soft carpet made out of recycled plastic, and are surrounded by a fence, but do not have as much and rich play opportunities as nature-based places have (Woolley & Lowe, 2013). The function of these KFC school playgrounds is mostly directed towards relaxing and recovering from the play and learning time in the indoor classroom, and less towards rich learning experiences (Chawla, 2014; Ramstetter et al., 2010).

As a consequence, play in outdoor settings is not valued for its potential benefits for children's learning development (Miranda et al., 2017). Instead, outdoor play time has been traded for learning time indoors.

In many of today's schools, indoor learning time has taken the form of a carefully planned curriculum of teaching basic skills, mostly focused on emergent math- and literacy skills. This educational view consists of teaching domain-specific learning,

from a 'direct instruction' perspective, to ensure appropriate knowledge for later academic success (Fisher et al., 2011). However, child initiative, freedom, and responsibility, which were the center of kindergarten pedagogy are difficult to reconcile with the characteristics of this more cognitive approach: worksheets, memorization tasks, and assessments. In addition, due to the demands of a modern society, functional literacy (i.e., a level of literacy needed to function in society) asked for increasingly higher-level reading skills, which resulted in an even greater emphasis on emergent literacy in ECE, than before (National Association for the Education of Young Children, 1998; Rogoff, 2003).

Consequently, early childhood language education got 'language-ized': practices and principles from formal language education in the later years, such as vocabulary teaching and repeated story reading and phonics activities, were copied at the cost of rich play experiences in rich learning environments (Masek, L. R., Scott, M. E., Dore, R., Luo, R., Hirsh-Pasek, K., & Golinkoff, 2018) which had its effect on preschool and kindergarten language curricula. I might summarize the design principles of this type of language education in the acronym KFC as well: Kid Fast Cognitive.

Today, many experienced ECE professionals argue that their language education, which has always been an argument for ECE, is too strict and prescribed, not leaving enough room for play as the context for the broader development of young children; a broader development of which emerging literacy and math skills, as well as motor skills, and social-emotional competence, are part (Rubin et al., 1983; Golinkoff et al., 2006; Nathan and Pellegrini, 2010). Whereas in ECE the time for indoor playtime has decreased, these teachers realize that outdoor play offers rich play opportunities. However, there is a lack of knowledge to make more of outdoor play time, more specifically, outdoor play time in nature-based places (Prins, van der Wilt, et al., 2022). ECE outdoor play as well as indoor language education went from Froebel's garden to KFC, and lost the supportive function of the garden for the broader development of their students (Miranda et al., 2017). Therefore, in this dissertation we explore how going back to the garden can support language education in ECE.

Benefits of nature for child development

Comparable to Froebel's description of the value of the garden as a context for child development, recently, research has consistently shown that playing in nature-based places (i.e., forest, green spaces, parks, gardens) is strongly advantageous for healthy child development (Tremblay et al., 2015). Nature-based places contain elements, such as vegetation and loose parts (sticks, trees, stones,) that offer children play and learning experiences that differ from non-nature-based play-

grounds with a paved surface and manufactured play elements, such as a climbing structure and a sandpit. What does the research show?

First, review studies into the relation between being in nature and a healthy child development showed that most of these studies focused on benefits for physical activity, mental health and connectedness to nature or environmental consciousness (Chawla, 2015; Dankiw Id et al., 2020; Gill, 2014). At the same time these reviews uncovered how specifically the characteristics of nature-based places impacted the way play was afforded, which led to more physical activity, improved mental health and a better connectedness to nature. Second, some studies showed a relation between children's language use and being in nature (Cameron-Faulkner et al., 2018; Richardson & Murray, 2016).

Some theoretical explanations for the benefits of nature for play

Although this dissertation focuses on early childhood I will first explain two theoretical approaches to the assets of nature-based places for human behavior in general: the Stress Recovery Theory (SRT) and the Attention Restoration Theory (ART) (Gibson, 2014; Kaplan, 1995; Ulrich, 1983). First, the SR-theory is a psycho-evolutionary theory that states that since humans evolved over a long period in natural environments, people are to some extent physiologically and perhaps psychologically better adapted to nature-based environments than to non-nature-based environments.

Second, the AR-theory is a psycho-functionalist theory that states that humans have an innate predisposition to pay attention and respond positively to natural content (e.g., vegetation and water) and to settings that helped survival during evolution. Both theories state that nature-based environments are more restorative compared to non-nature-based environments. According to SRT, nature-based environments relieve physiological stress, and according to ART, nature-based environments restore mental fatigue. Since the SRT and the ART state that nature can influence human behavior, it is reasonable to expect that nature-based environments also contribute to children's play behavior. For example, one of the criteria mentioned by Burghardt (2012) in the *Oxford handbook of the development of play*, that characterizes play of all animals, is: play is only initiated when the animal is "relaxed": well fed, warm and safe. Another important aspect of play is that it asks for attention and involvement (Rubin, Fein, & Vandenberg, 1983). Nature-based environments contribute to both conditions that are required for play.

How play quality and the physical environment are related

Play is a major aspect of children's life in most cultural communities (Roopnarine, 2012). In fact, play is seen as a key element of child development because it is the context for the development of cognition (including language), motor skills and social-emotional competence (Rubin et al., 1983; Golinkoff et al., 2006; Nathan and Pellegrini, 2010). Wynberg and colleagues (2022) developed a comprehensive framework, in which they bring together several theoretical perspectives on play, to argue how play and the physical environment are related (Wynberg et al., 2022).

First, according to Piaget in *Play, Dreams and Imitation in Childhood* (Piaget, 2013), children incorporate objects and events of the world around them in their play, creating a mental model of the world. In this genetic epistemology perspective, children's level of cognitive development is reflected in types of play (functional and constructive play, symbolic/fantasy play and games with rules). Children's play can be classified based on their cognitive development. Piaget's theory of cognitive development suggests phases in which intelligence changes as children grow. During the first twelve years of their life they grow from sensorimotor intelligence (understanding the external world by only sensing and touching objects that are present, via the preoperational intelligence (understanding the world on a symbolic level, but still without using cognitive operations, they still need interactions with the physical world to perform these operations) into the phase of concrete operational intelligence (understanding the world by using logic and transform, combine and separate concepts, without the need to physically interact with the physical world). Piaget's description of this developmental trajectory shows that the physical world is a necessary part of children's developing intelligence. However, in this view, children's play is not seen as a context for new development. Therefore, this theoretical perspective does not explain how children's play quality and the physical environment are related.

Second, in contrast to Piaget's view that play reflects the actual level of children's cognitive development, in Vygotsky's cultural historical activity theory (CHAT), play is considered a context for development. With help of parents, educators and peers, in play children gain a driving force for further cognitive, social-emotional, and motor development (Nicolopoulou, 1993). Leontiev advanced Vygotsky's theory by differentiating play actions from play activity. Play actions are performed to achieve a single goal. Play activity is a set of related play actions that meet children's need to get to know the world around them and be able to contribute to it. Their play activity derives its meaning from the satisfaction of fulfilling this need, which is the motive

for their activity. However, the goal of a play action does not necessarily coincide with the motive of the activity. In fact, the single goal of an action often comes apart from this motive. For instance, children in a nature-based environment collect sticks (action) to build a pretend bonfire (activity) to fulfill their need to get the feel of making a bonfire (not because they were cold or needed to cook). This example points towards the importance of the quality of the physical environment for the developmental power of the play activity. This is specifically seen in the importance of tool use within CHAT. Tools help children to fulfill their need, and these (symbolic) tools link the action (collecting sticks) to their motive (to get to know bonfires by pretending to make one). In other words, children are motivated by these physical tools. In the play context, tools have agency to achieve goals (Bodrova and Leong, 2015; Wynberg et al., 2022), and motivation to use the tools is what makes children act, think and develop (Nicolopoulou, 1993; Deci and Ryan, 2008; Bakhurst, 2009). As a result of engaging in play, the perceptual world –i.e., the physical world that the child meets through perceptually interacting with it– becomes a conceptual world of meaning and value. In this process, language and play go hand in hand towards lifting the perceptual world into the domain of our thinking. In play, children develop the mental power to understand the (meaning of the) world that surrounds them (Bakhurst, 2009). In the example of children building a bonfire, the sticks mediate between the perceptual and conceptual world. Children use their mental power to imagine the real fire and the heat that comes from it, while building the bonfire and gathering around it. Although CHAT accounts for the role of the physical environment in children's play, the environment is mostly viewed as situated in a socio-cultural environment not specifically related to nature as a play environment.

Thirdly, Gopnik (2020) describes childhood from an evolutionary perspective. In this perspective childhood, not play, is seen as the context for development. Childhood is the time for the human mind to explore the unpredictable range of human possibilities. In this view, during childhood, children are especially prone to explorative and "active" learning, which helps them rapidly navigate a wide scope of environmental and behavioral possibilities. Moreover, this type of learning is demonstrated in messy and intuitive play actions, nevertheless, they result in gathering new information about the world around. Without using adult intelligence, such as planning or focused attention, children are learning and adapting to the world around, provided that they get the opportunity to get involved in this world with all their senses. Messing around in a rich environment, during intuitive play actions, helps them to imagine even far away and unlikely hypotheses. For example, using

objects during play in a creative way, using a block as a phone, or a stick as spoon, not being hindered by experience of the usual function of the object (Gopnik and Wellman, 2012; Schulz, 2012; Wente et al., 2019). Within the evolutionary perspective, children need an environment that is variable, with a mix of predictability and unpredictability, and childhood is an extended time for exploration of this environment. In the same way as the CHAT, within the evolutionary perspective the focus is on cultural learning, i.e., obtaining information from other humans in cultural environments, without specific focus on explorative play in nature-based places.

Whereas these three play approaches describe how play (and childhood) are considered as a context for child development, they do not explicitly describe how play needs a physical context, a place. Adding insights from the affordance theory helps us to understand the relationship between the quality of the place where the play appears, and play quality (Gibson, 2014). Gibsons's affordances theory is a way to describe an environment in terms of the distinctive features that offer possibilities for play behavior for a child or a group of children. An affordance is something that refers to both the environment and the skills of a child at that moment. For instance, a tree can afford leaning for a 1-year-old, hiding for a 5-year-old and climbing for a 7-year-old. Heft (1988) and Kyttä (2002) advanced the affordances theory into a functional taxonomy, by describing the distinctive functional properties of an environment, properties that are both objectively real and psychological relevant.

Functional properties are different from form-based classifications. Form-based classifications are used to describe features of a (play) environment independent of what they mean for a specific individual. Form-based classifications are used to design traditional playgrounds: for instance, the form of a swing, or a slide mandates what can be done with it: swinging and gliding. However, a functional affordance is a way to describe the setting, the person (the child with her skills at that moment) and the action as a "system." According to Heft (1988), environments considered from a functional perspective, can have a developmental dimension, whereas a form-based orientation is a-developmental. In Hefts (1988) words, functional environments that drive development have all kinds of jump-off-able, walk-on-able, grasp-able, tear-able, splash-able (and so on)' functions. Using Heft's taxonomy, I can argue that nature-based environments contain more developmental functions compared to paved playgrounds that are designed on form-based principles, such as the earlier mentioned KFC playgrounds around schools (Heft, 1988; Woolley, 2007). Whereas nature-based places have functional properties that can enhance the quality of play experiences, the question remains if nature-based places have functional properties that afford rich language experiences.

How language development and the physical environment are related

Children learn to use language in a rich language learning environment that is characterized by exposing children to high quality linguistic input, consisting of carefully chosen words, grammar and sounds and providing the opportunity for extended discourse (Justice, 2004; van der Veen et al., 2017). First, according to Tomasello's (2003) usage-based language approach, three social-cognitive skills enable children to learn to use language: (1) joint attention (the skill to share and follow other's attention on objects and events), (2) intention reading (the skill to understand others' communicative intentions), and (3) cultural learning (the skill to imitate others). These three skills make it possible to learn lexical labels and to discover grammatical patterns while using language.

Second, in a rich language learning environment, adults are highly responsive to topics initiated by the child and new language input is often repeated (Girolametto & Weitzman, 2002). Furthermore, rich language learning environments provide opportunities for the child to actively engage in linguistic interaction as well as passively overhear linguistic interaction from others (Deunk, 2009; Girolametto et al., 2006). It is worth noting that Cameron Faulkner et al. (2018) demonstrated how nature-based places increased the amount of responsive and connected verbal interactions between parent and child. They explain their results by relating the importance of joint attention for learning to use language in social contexts, to the restorative function of nature on stress and attention.

Third, while language environment is mostly defined across the social and interactional dimension, Rowe and Snow (2019) emphasize the conceptual quality as part of a language rich environment. Traditionally, this conceptual quality in early language education is found in environments that refer to cultural practices, such as a bakery, an art center, or a farm. In addition, specifically for early childhood language education, books are used, or early literacy stimulating props such as pens and papers (K. A. Roskos et al., 2010). However, the garden, that used to be a place where meaningful experiences during self-initiated exploration were part of the broader development of children, including their language development, also contains rich conceptual quality for language development. When children play in nature-based places, these rich concepts are likely part of the words and sentences they use during play in nature.

Finally, these rich life and science concepts do not slip into children's words and sentences without children's embodied interaction with them; in other words, without playing with them (Ionescu & Ilie, 2018; M. Wilson, 2002). Play and language

together make it possible to lift the concepts of the environment where we play, into the domain of our thinking, as the Dutch historian Johan Huizinga stated this in his famous book *Homo Ludens* (Huizinga, 2014). Through play, concepts of a rich environment become part of our thinking. The concepts we use in thinking are part of our mental lexicon (Aitchison, 2012). This is a semantic network that connects all characteristics of a word, such as the meaning, the grammatical aspects as well as the pronunciation. The depth of word and concept knowledge increases when the number of connections between words grows. This not only happens when children learn a new word, but also when they learn new aspects of words they already know (Schoonen & Verhallen, 2008). For instance, the number of connections between aspects of the concept 'gravitation' grows by rolling logs of different weight of a slope. The sensory aspects of the logs play a role in the connections that grow. The more a child can experiment with the different aspects of the concept the more connections grow. The connections not only grow when children learn to understand new words (passive vocabulary) but children also need to have the opportunity actively use these words (Langeloo et al., 2019; Tomasello, 2012).

The contribution of this dissertation

The possible beneficial function of nature for language development in ECE is relatively unknown and unstudied. Based on the theoretical explanations for the benefits of nature for play quality, and the relation between play quality and language production, I expect that nature as a place for play, can have a supportive function for language development in ECE. The two central research questions of this dissertation are:

1. How are nature-based learning environments and language development related for children aged 2-7 years?
2. How can early childhood educators make nature-based places function as language learning environments in their language education?

With this dissertation I aim to contribute to the research field conceptually as well as to extend the empirical evidence base of the benefits of nature for children, by focusing on its supportive function for language development. Besides, I aim to use insights from this dissertation to inform practitioners. The aim is threefold: the first is to provide a systematic review of the literature on qualitative studies into the benefits of nature for play in ECE. This is essential since most reviews on the benefits of nature for children's development focused on health, both mental and physical, and not so much on cognitive development. Moreover, a systematic review

of qualitative studies can synthesize the fragmented literature of small studies into a knowledge base that can inform early childhood educational practices, valuing nature-based play environments as intrinsically linked to play quality. The second aim is to explore how play in nature-based places contributes to both the quantity as well as the quality of children's utterances during play. This is necessary since there are only very few studies into the relation between playing in nature and language production. The third aim is to investigate how early childhood professionals can include the supportive function of nature-based places into their practice, to improve their language education.

Methodology

The studies presented in this dissertation are a systematic literature review and three empirical studies. For these three empirical studies different designs were adopted. I started with a mixed methods experiment, an intervention to study the possible relation between language use and play in nature-based places with children aged 4-7 years, in the first years of primary school in the Netherlands. As mentioned earlier, the benefits of playing in nature for language development is rather unstudied. Therefore, it seemed necessary to first qualitatively investigate this relation before we followed up with a quantitative study. Besides, for practical reasons we decided to first study the value of nature play in primary school, before adapting the same design to younger children aged 2-4 years in preschool. In both studies language samples were taken, using voice recorders, sewn onto a play jacket, during play in two conditions, a nature-based playground and a non-nature-based playground. Our third empirical study consisted of collaborative action research in five communities of practice, in which researchers and early childhood professionals in preschool and in the first years of primary school participated. In these communities we aimed to get insight into the possibilities of nature-based language education. The methodology that was used in this dissertation made it possible to get a broad overview of the supportive function of nature for language development by listening to and analyzing the voices of the children and the voices of their teachers. At the same time, I identified how the extant literature pointed us towards the importance of understanding what play is when studying young children as well as how play, language and the physical play context are related. The studies were all conducted in the context of a normal school day with groups of children led by their own teachers, which accounts for considerable ecological validity.

Research Context

The three empirical studies described in this dissertation were conducted in Dutch ECE groups: daycare, preschool and primary school. In the Netherlands, 60 % of the two- to four-year-old children attend either formal centre-based day care or pre-school before they enter primary school at four years old. Over 93% of four-year-old children start primary school, yet primary school is compulsory only from the age of five. Children usually enter group (grade) one in primary school shortly after their fourth birthday. In most schools it is common practice to combine groups (grades) one and two (with children aged 4-6). In rare situations also combinations with group (grade) three are made (the grade where they start formal reading education), which was the case in one of our research schools. Hence early childhood classrooms in the Netherlands consist mostly of children in the age between four and six, in our research, we also had some seven-year-olds. The early childhood centres and primary schools in our project were located in highly urbanized neighbourhoods. Four of these five locations did not have an all nature-based playground; however, they all had either access to a public park or a garden within walking distance, or their playgrounds contained (small) nature-based areas.

Dissertation overview

Chapters 2-5 of this dissertation describe four studies into the relation between nature as a physical play space and child development, more specifically language development.

Chapter 2: A systematic literature review of qualitative studies

Play in nature-based environments in childhood education has positive benefits for child development. With this review we did attempt to understand how and why nature-based environments contribute to play quality. After a comprehensive search of the literature, we selected 28 qualitative studies with an overall sample size of N = 998 children aged 2–8 years. The studies were synthesized using an adaptation of Noblit and Hare's meta-ethnographic approach. We described the aspects of play quality that are related to nature-based environments as well as the aspects of nature-based environments that support play, and lastly the aspects of teacher-child interactions that contribute to nature play quality. We argue in the first place that future research into the relation between nature as physical play place and child development (including our own empirical studies) will benefit from thoroughly conceptualizing the role of play in child development. Secondly, when using the affordances theory as a framework for understanding the relation between nature

as physical play place and child development we have to move beyond single play actions as a unit of analysis. Finally, from an educational perspective it is important to shift the focus of nature play from the health perspective towards its benefits for children's cognitive development. These findings provided directions for the three empirical studies reported in chapters 3 to 5.

Chapter 3: Explorative study into relation between play in nature-based places and language use

Our review study suggested that aspects of play quality and aspects of nature-based play spaces are related. At the same time the review described the importance of research into the benefits of nature play for cognitive development. Therefore, in this study, we explored the relation between playing in natural environments and children's language use. A total of 18 children aged four to seven from three Dutch primary schools participated. To measure children's language use during outdoor play, we recorded their utterances for ten minutes while playing in a non-nature-based playground and a nature-based playground. Audio tapes were transcribed and coded using a coding scheme focusing on communicative functions. Findings indicated that children used more language and more complex language while playing in the nature-based playground. Additionally, four themes were identified: (1) Children used language to refer to their play situation, (2) Children used language to refer to the elements of their physical play environment. (3) Compared to the non-nature-based playground, children talked more about the objects of the nature-based playground, and (4) Children talked more about science and math concepts. Play in the nature-based playground appeared to be a richer conversational setting for language use than the non-nature-based playground, with a potential to scaffold and guide language use.

Chapter 4: How preschooler's language use during play in nature-based places is connected to the play place, a quantitative approach

The explorative study in chapter 3 described how language use during play in nature-based places was closely connected to the physical place. Compared to playing in non-nature-based places, children used semantically more complex language to refer to the nature-based environment around them. However, we also found that children were more talkative in the nature-based place, they used more utterances. This led to our third study: we replicated the research design of the earlier study, but we chose younger participants: 30 children aged two to four, since during these years of age children develop the foundations of their language. Furthermore, in this

study we took a quantitative approach and measured both language quantity as well as language quality by comparing the total amount of words and the total amount of unique words used by children during a 10-minute play period in a nature-based place and a 10-minute play period in a non-nature-based place. We found that the nature of the environment influenced the total number of words and of unique words spoken by the preschoolers, in the nature-based place they used more words and more unique words than in the non-nature-based place.

Chapter 5: Nature as co-teacher in early childhood language education

In this chapter we report on a study with early childhood teachers in preschool and the first years of primary school (kindergarten), where they explored how they could work with children on language education while being in nature. ECE professionals are especially interested in how to stimulate the language development of their students since they know that language skills are an essential predictor of school success. We worked with 55 teachers in communities of practice to explore the supportive function of nature-based places for language education. Together we systematically developed a new practice of language education, focused on supportive aspects of these places with an innovative approach: the acknowledgement of the agency of the nature-based place as an active participant in language education.

Chapter 6: General Discussion

This dissertation ends with a general discussion in which I integrate the findings of the previous chapters and critically discuss the conceptual findings and the empirical results and how they contributed to the understanding of the function of nature-based places for child development, more specific for early childhood language development. Furthermore, I discuss this dissertation's strengths and limitations and provide possible recommendations for practice as well as theoretical implications. Finally possible directions for future research are described.

2

Nature play in early childhood education: A systematic review and meta ethnography of qualitative research

This chapter is based on:
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Abstract

Play in nature-based environments in childhood education has positive benefits for child development. Although previous reviews showed the benefits of play in nature-based environments for child development they did not attempt to understand how and why nature-based environments contribute to play quality. This review aims to explore the value of play in nature-based environments compared to non-nature-based environments for developmental outcomes of young children (2-8 year). We searched for studies that investigated the relation between play and nature-based environments on the databases PsycINFO, ERIC and Web of Science. Inclusion/exclusion criteria were: (1) the study focused on play in/on a nature-based environment, (2) the study included participants between the age of 2-8 years, (3) it was an empirical study, (4) the study was conducted in the context of early childhood education (ECE), and (5) the study included participants without special needs or disabilities. Using these criteria, we selected 28 qualitative studies with an overall sample size of *N* = 998 children aged 2-8 years. The studies were synthesized using an adaptation of Noblit and Hare's meta-ethnographic approach. Three overarching themes were found: (1) the aspects of play quality that are related to nature-based environments, (2) the aspects of nature-based environments that support play, and (3) the aspects of teacher-child interactions that contribute to nature play quality. The meta themes resonate with play theories and theories of the restorative value of nature. We draw on the qualitative data to refine and extend these theories, and to come up with a definition of the concept 'nature play'. This systematic review also sets a base for future research on play interventions in nature-based environments. We argue that (1) research will benefit from thoroughly conceptualizing the role of play in the development of young children, (2) using the affordances theory research will benefit from moving beyond the individual play actions as a unit of analysis, and (3) from an educational perspective it's important to shift the focus of nature play to its benefits for children's cognitive development.

Introduction

In early childhood education (ECE), play and learning are inextricably intertwined (Hirsh-Pasek et al., 2010). Play is often considered as a context for young children's learning and development, and can take place indoors (e.g., in a classroom) as well as outdoors (e.g., in a nature-based environment). However, outdoor play in ECE is often done for its value to relax and recover from the important play and learning time that takes place indoors. As a result, in ECE play in outdoor settings is not often valued for its potential benefits for children's learning development. (Miranda et al., 2017). Recently, many studies have focused on play and learning in nature-based environments. Based on these studies, this review aims to explore the value of play in nature-based environments in ECE. The research for this review was guided by the following question: what is the value of play in nature-based environments compared to non-nature-based environments for developmental outcomes of young children (2-8 year)?

Play as a context for child development, three perspectives:

In most cultural communities, play is a major aspect of children's life (Roopnarine, 2012). Most play researchers agree on the importance of play in early childhood. In fact, play is seen as a key element of child development because it is the context for the development of cognition (including language), motor skills and social emotional competence (Golinkoff et al., 2006; Nathan & Pellegrini, 2010; Rubin, Fein, & Vendenberg, 1983).

To affirm the importance of play, in Article 31 of the United Nations Convention on the Rights of the Child (UN, 1989) play is viewed as a fundamental need and right of children. This need for and right to play needs to be respected in the lives of young children. Consequently, article 31 challenges us to understand play from the perspective of children's needs and rights.

Before play ended up as a fundamental right in the Children's Rights Treaty, the critical role of play has been studied by many scholars using different theoretical frameworks. According to Wynberg et al. (2022), roughly three theoretical perspectives can be distinguished. First, Piaget describes in *Play, Dreams and Imitation in Childhood* (Piaget, 2013), how children incorporate objects and events of the world around them in their play, creating a mental model of the world. In this genetic epistemology perspective, children's level of cognitive development is reflected in types of play (functional and constructive play, symbolic/fantasy play and games with rules). Piaget's theory of cognitive development suggests four phases in which intelligence changes as children grow in. For early childhood the first three are

relevant: children (0-12 year) grow from sensorimotor intelligence (e.g., children understand the external world only by sensing and touching objects that are present), into preoperational intelligence (e.g., during this period children are thinking at a symbolic level but are not yet using cognitive operations, they still need to act in the external world to perform these operations) into concrete operational intelligence (e.g., children can use logic and transform, combine and separate concepts on a mental level) In this way, children's play can be classified on the basis of their cognitive development, but children's play is not seen as a context for new development. Therefore, this theoretical perspective does not explain how children's play quality and the physical environment are related.

Secondly, in contrast to Piaget's view that play reflects the actual level of children's cognitive development, in Vygotsky's cultural historical activity theory (CHAT), play is considered a social activity in which children meet and interact with the social cultural environment. With help of parents, educators and peers, children gain in play a driving force for further cognitive, social-emotional and motor development (Nicolopoulou, 1993).

Leontiev advanced Vygotsky's theory by differentiating play actions from play activity. Play actions are performed to achieve a single goal. A play activity is a set of related play actions that meet children's need to get to know the world around them and be able to contribute to it. Their play activity derives its meaning from the satisfaction of fulfilling this need, which is the motive for their activity. However, the goal of a play action does not necessary coincide with the motive of the activity. In fact, the single goal of an action often comes apart from this motive. For instance, children in a nature-based environment collect sticks (action) to build a pretend bonfire (activity) to fulfil their need to get the feel of making a bonfire (not because they were cold or needed to cook).

Within CHAT, tool use is an important aspect of play activity. Tools help children to fulfil their need and these (symbolic) tools link the action (collecting sticks) to their motive (getting to know bonfires by pretending to make one). In other words, children are motivated by these tools. In the play context, tools have agency to achieve goals (Bodrova & Leong, 2015; Wynberg et al., 2022) and motivation to use the tools is what makes children act, think and develop (Bakhurst, 2009; Deci & Ryan, 2008; Nicolopoulou, 1993). As a result of engaging in play, the perceptual world - i.e. the world the child meets through perceptually interacting with it - becomes a conceptual world of meaning and value. In this process, the child develops the mental power to understand the (meaning of) the world that surrounds him/her. The

perceptual world invites or affords play activity (Bakhurst, 2009). In the example of children building a bonfire, the sticks mediate between the perceptual and conceptual world, children use their mental power to imagine the real fire and the heat that comes from it, while building the bonfire and gathering around it. Although CHAT accounts for the role of the physical environment in children's play, the environment is mostly viewed as situated in a socio-cultural environment.

Thirdly, Gopnik (2020) describes childhood from an evolutionary perspective as a time for the human mind to explore the unpredictable range of human possibilities. To develop the capacity to navigate the perceptual world, in other words to get the feel or hang of it, children actually have to feel the world and hang around in it. During childhood, children are especially prone to explorative and 'active' learning. While involved in messy and intuitive play actions, children gather new information about the world around them, learning and adapting without using adult intelligence, such as planning or focused attention. Instead, they get involved with all their senses to imagine even far-away and unlikely hypotheses, such as using objects during play in a creative way, not being hindered by experience of the usual function of the object (Gopnik & Wellman, 2012; Schulz, 2012; Wente et al., 2019). Within the evolutionary perspective childhood is an extended time for exploration of an environment that is variable, with a mix of predictability and unpredictability. In the same way as the CHAT, within the evolutionary perspective the focus is on cultural learning, i.e. obtaining information from other humans and not so much from the interaction with the nature-based environment.

Although these three perspectives differ in focus and methodology, they all acknowledge play as important for child development. During play children find out the meaning of the world that surrounds them, including the physical world, and learn how they can interact with it. In this way they develop as human beings with cognitive, social, emotional, and motor competencies.

Defining play

In this review, we focus on play and how the quality of play might be supported by the physical environment where children play. Therefore, we need a definition to distinguish play behaviour from other behaviour. As we have seen in the literature on play there is no defining key factor that connects all actions that are recognised as play actions. In *the Oxford handbook of the development of play*, Burgerhardt (2012) comes up with a set of five criteria that characterize the play of all animals: (1) It is not fully functional in the form in which it is expressed; play actions can look functional but the actions do not contribute to survival; (2) It is spontaneous,

voluntary, intentional, pleasurable and done for the sake of playing; (3) Play differs from functional behaviour in structure or timing in at least one respect: incomplete, awkward, precocious; (4) It is performed repeatedly but not in a stereotyped way; (5) It is initiated when the animal is 'relaxed': well fed, warm and safe. These five criteria partly overlap with the dispositions described by Rubin, Fein, & Vandenberg (1983). They define play as: (1) intrinsically motivated; (2) for the sake of play(ing); (3) deriving pleasure from it, and (4) having the freedom to modify the rules within the play (Rubin, Fein, & Van de berg, 1983). For this review, we will combine the aforementioned criteria and include all behaviours that can be classified as a child's interaction with the environment, while being highly involved, intrinsically motivated, deriving pleasure from it, and having the freedom to modify the rules (cf., Rubin et al. 1983).

The quality of the physical environment in relation to play quality

The physical environment where children play is part of their play. The value of explorative and active play is directly related to both the complexity of the physical environment and the opportunity to incorporate the environment in play (Gopnik, 2020). In other words, an environment not only serves as a play décor, but it also serves as a place that affords play. For example, findings from systematic reviews consistently demonstrate that a nature-based environment affords different play behaviour compared to non-nature-based environments (Dankiw Id et al., 2020; Gill, 2014; Zare Sakhvidi et al., 2022). How can this be explained?

The affordances theory of Gibson (2014) is a way to describe an environment in terms of the distinctive features that offer possibilities for play behaviour for a child or a group of children. An affordance is something that refers to both the environment and the skills of a child at that moment. The affordance theory helps to understand why nature-based environments differ from non-nature-based environments. For instance, a tree can afford leaning for a 1-year-old, hiding for a 5-year-old, and climbing for a 7-year-old. Heft (Heft, 1988; Kyttä, 2002) advanced the affordances theory into a functional taxonomy, by describing the distinctive functional properties of an environment, properties that are both objectively real and psychological relevant. It is a way to describe the setting, the person (the child with her skills at that moment) and the action as a 'system'. According to Heft (1988), the functional possibilities for meaningful play that children perceive in nature-based environments are different from the possibilities they perceive in non-nature-based environments.

In addition to the affordances theory to describe the assets of nature-based environments for play, two complementary theories from research on nature-based environments are related to aspects of play (quality) as well: the Stress Recovery Theory (SRT) and the Attention Restoration Theory (ART) (Berto, 2014; Kaplan, 1995; Ulrich, 1983). SRT is a psycho-evolutionary theory that states that since humans evolved over a long period in natural environments, people are to some extent physiologically and perhaps psychologically better adapted to nature-based environments as to non-nature-based environments. ART is a psycho-functionalist theory that states that humans have an innate predisposition to pay attention and respond positively to natural content (e.g., vegetation, water) and to settings that helped survival during evolution. Both theories state that nature-based-environments are more restorative than non-nature-based environments; according to SRT, nature-based environments relieve physiological stress whereas according to ART, nature-based environments restore mental fatigue. In this way nature-based environments contribute to play quality as we look at the criteria for play quality mentioned above: a child can only initiate play when it is relaxed, and play asks for involvement and attention.

Defining Nature-Based Environments

As we see how the quality of the play activity of a child is intrinsically linked to the nature-based environment, we need a definition to distinguish a nature-based environment from other environments. As it is difficult to find one key factor to define play, there is also no such key factor that connects all environments recognised as nature-based environments. To describe such an environment the affordances theory of Gibson (Gibson, 2014; Greeno, 1994; Lerstrup & Konijnendijk van den Bosch, 2017) makes it possible to look at an environment in terms of affordances. He described five affording features of an environment: (1) places, (2) attached and (3) detached objects, (4) substances and (5) events. In this review, we use these features to distinguish nature-based environments from non-nature-based environments. Nature-based environments (1) have a surface (place) that is the basis for growth of living elements, (2) provide possibilities for interacting with living, non-man-made elements like plants, trees, insects, (3) these living elements 'provide' loose materials to play with, such as sticks, seeds, feathers and shells (attached and detached 'objects'), (4) non-living elements are part of a nature-based environment as these elements are connected to the biosphere of the living elements such as water, rocks and soil (substances), and (5) weather elements such as fresh air, rain,

wind and sunshine, or seasonal elements such as blooming or decay are the features that ensure change (events) (Chawla, 2015; Dankiw Id et al., 2020; Gill, 2014).

The role of the teacher

For this review, we also investigated the role the teacher has in designing and/or choosing the play environment. The motivation and the capacity to be taught by the world is not totally innate. It needs to be nurtured and sustained by adults. Early childhood teachers are part of the play context and have a role in mediating between the child and the world. In this context they also have a role in the acquisition and use of language during play. While the perceptual world with its structure and rules becomes a conceptual world in play the acquisition and use of language makes it possible to store the concepts in the mind (Huizinga, 2014). Most play theories agree on the role early childhood teachers have in guarding children's play, enriching children's play environment, and protecting children for dangers, but there is considerable debate on the question if and how adults should participate in children's play activities (van Oers, 2013).

Reason for this review

Reasoning from play theories and the environmental psychologist theories we might expect that nature-based play environments, as an indivisible part of children's play actions, can contribute to children's cognitive, social emotional and motor development.

In the last decade, many studies have been conducted into the relation between a healthy development of children and engagement in nature-based environments. Most of these studies have focused on health and physical activity. The reviews of Gill (2014), Chawla (2015) and more recently Dankiw et al. (2020) have provided overviews of the benefits of nature for children's development. These reviews were focused on children between 1 and 12 years old. First, the systematic review of Gill showed the benefits of children's engagement with nature on mental health as well as physical activity. Second, Chawla's work was not so much a systematic review but a thorough reflection on research into the benefits of nature contact for children. She placed the research in the context of changing research approaches, thus showing how different research questions and methods shape our understanding of the benefits of access to nature for children. Third, Dankiw's review investigated the impacts of children's engagement with unstructured nature play, finding that unstructured nature play may have a positive impact on different aspects of child development. By focusing on developmental outcomes of quantitative studies, this

study did not attempt to understand how or why unstructured nature play is related to these positive outcomes. A systematic review of qualitative studies can synthesize findings and advance the knowledge base of how nature-based environments contribute to play quality. Synthesizing the fragmented literature will contribute to a useful resource for guiding future research on this topic and inform ECE practices, valuing nature-based play environments as intrinsically linked to play quality.

We systematically reviewed studies into play in nature-based environments in ECE. These studies may contribute to our understanding of the experiences of children and teachers in ECE when going outside to play in nature- based environments. Moreover, these experiences set out a basis for understanding the possibilities of playing in nature-based environments for cognitive, social emotional and motor development in ECE. We reviewed studies in ECE settings since in these settings play is an important part of the curriculum.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Page et al., 2021)was adopted for the purposes of the present review. A PRISMA checklist is provided in appendix 2.1.

Inclusion and exclusion criteria

Articles were included if they met the following selection criteria:

(1) the study focused on play in/on a nature-based environment (studies were excluded if the exposure to nature was not specified as 'interaction' or 'play' or if the environment where the children played did not match our criteria of nature-based environments as stated in our introduction)
(2) the study included participants between the age of 2-8 years
(3) it was an empirical study
(4) the study was conducted in the context of early childhood education (ECE) (studies were excluded if they were not conducted in a centre for ECE, such as day care centres and preschools)
(5) the study included participants without special needs or disabilities

Databases and search query

Databases PsycINFO, ERIC and Web of Science were used to identify studies that investigated the relation between play and nature-based environments. To ensure the quality of the studies we only included empirical studies that were published in peer-reviewed journals. Furthermore, studies written in English that were published

between 1995- May 2022 were included. We combined keywords on the two major concepts of this review: play and nature-based environments. To ensure a comprehensive search the following keywords were used for play or activity: manipulative play, object play, relational play, block play, loose part play, outdoor play, free play, unstructured play, rough and tumble play, explorative play, creative play, construction play, physical play, gross motor play, role play, pretend play, social play, imaginative play, socio dramatic play, social pretend play, as if play or physical activity, unstructured activity, explorative activity, physical activity, construction activity, gross motor activity. For the nature-based environment, the following keywords were used: green or natural environment, playground, landscape playscape setting area or space, school garden, school forest, school wetland, school wilderness school grassland, greenery, garden, forest, wetland, wilderness, grassland, tree cover, tree canopy, biodiverse school ground, nature-based. Boolean operators were used to ensure that each possible combination of keywords was included. The search query is provided in appendix 2.2.

Selection procedure

The primary search resulted in a selection of 5961 articles. Next, duplicates were removed, and titles, abstracts, and keywords of the remaining articles were manually screened. Many studies in this first selection were either in the field of environmental science or health and did not concern playing children. After removing the studies that obviously did not meet our selection criteria we assessed 166 articles for eligibility. We excluded 107 studies for reasons of age. We also screened studies with participants between 2 and 8 years as well as participants beyond this age. We did not include them because it was impossible to decide if the results were specific for the group of children between 2 and 8 years. A random selection of twenty articles of the 166 articles were checked with two researchers, both members of a research group performing a systematic review in the field of ECE. They checked if the article met the criteria of our definition of play and nature-based environment as stated in our introduction. Quality appraisal was made through the Joanna Briggs Institute (JBI) Critical Appraisal Tool for Qualitative Studies (Lockwood et al., 2020) (see appendix 2.2). Using this tool, we were surprised by the innovative and creative ways these studies adapted to respect the voice of young children. We ended up with a final selection of 28 studies with an overall sample size of *N* = 998 children aged 3-8 years. See Figure 2.1 for an overview of the study selection process.

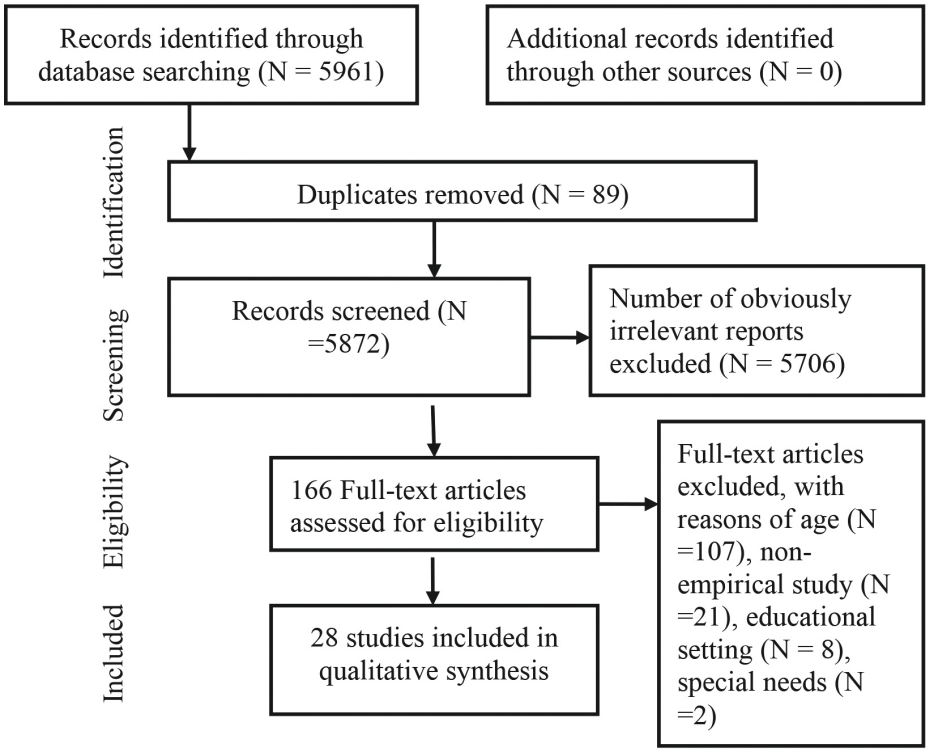
Data extraction and synthesis

The selected studies were analysed and synthesized in four steps based on Noblit and Hare's meta-ethnography method and adapted for this study ((Agar, 1990; Noblit & Hare, 2012; Nye et al., 2016): **Step 1**: The studies were read and re-read to gain a detailed understanding of their theories and concepts and their findings according to the following categories: (1) Design/method, (2) theories and conceptualization, and (3) outcomes. Table 1 (provided in appendix 3) gives an overview of the 28 studies, specified according to these categories. To retain the meaning of the primary concepts within individual studies and to define the relations between these concepts we developed codes regarding the experiences of children and teachers while playing in nature-based environments during ECE (i.e. authors' interpretation of the data, 'second order constructs').

Step 2: In order to determine how the studies were related, the initial codes were grouped according to key aspects of (1) play quality, (2) the nature-based environment and (3) the teacher-child interactions. These key concepts from individual studies were synthesised, which resulted in lists of overarching themes for each of the three groups (see figure 2).

Step 3: Studies were translated into one another to produce 'meta-themes' across the different aspects of play in nature-based environments. To draw out the findings under each meta-theme, some studies were chosen as 'index' papers from which we extracted findings. These index papers stood out in terms of their conceptual richness. Their findings were then compared to and contrasted with the findings of a second study, and the resulting synthesis of these two studies were then contrasted with a third study, and so forth. This is referred to as 'reciprocal translation'(Noblit & Hare, 2012; Nye et al., 2016). For example, Lerststrup and Konijnedijk van den Bosch advanced Gibsons and Hefts theory of affordances and functional classes of outdoor features into 'key activities' afforded by classes of the outdoor environment. These new concepts were used for the translation of concepts from other papers that were related but not conceptualized in this way. (Lerstrup & Konijnendijk van den Bosch, 2017)

Step 4: The meta-themes from step 3 were synthesized according to aspects of quality of ECE. Via interpretive reading of these meta-themes, we developed a 'line of argument' synthesis regarding the value of play in nature-based environments for improving developmental outcomes of ECE. This is presented in the discussion.



Figuur 2.1 *Study selection process*

Results

Meta method analysis

During step 1 we analysed the study designs of the 28 included studies. The studies into play in nature-based environments in ECE all aimed to get more insight into the relation between children's play and nature-based environments in ECE. The studies aimed to study a myriad of educational outcomes, such as physical activity, cognitive, social emotional and motor development as well as health. The relevance of these studies is motivated by concerns about changes in the practice of playing outside as healthy practice for young children's physical and mental wellbeing. Opportunities for outdoor play have diminished drastically since the mid-20th century, due to cultural changes such as parental control and fear, inadequate access to outdoor playgrounds, screen time and the focus on cognitive development in ECE.

The studies included in the present review can all be characterised as small-scale studies using observations of play behaviour in nature-based environments and interviews with teachers and children to explore their experiences of playing

in nature-based environment. Participating early childhood settings in the studies were sampled based on their outdoor play practices including the design of their playgrounds. These studies can be divided into two groups: one that compared play on a nature-based (part of the) playground to play on (part of the) traditional designed playground and one that compared forest school practice to indoor/outdoor classroom practice.

In all studies, except for one, the sample size was given and ranged between N=4 and N=198, with a total of N= 998 and a mean of N=36. Twelve of the studies had a sample size of <N=20, thirteen had a sample size between N= 20 and N=100, one study had a sample size of N=198, and one had a sample of teachers N= 63 teachers. One study did not specify the sample size. The relatively small sample sizes of most studies can be explained by the fact that the studies had an explorative and qualitative research design.

Seventeen studies used play observations describing different aspects of the relation between children's play behaviour and nature-based outdoor environments, to get more insight in how children use outdoor environments during outdoor play activities. In most studies these observations were characterized as phenomenological, ethnographical, and participatory. Blanchet-Cohen & Elliot (2011) for instance described how participatory observation was a primary method of listening to young children in unmediated ways to get insight in how the children used the nature-based environment. In the studies of Moore et al., (2021) and Dyment & O'Connell (2013) observation was done by using event sampling or taking scans with an observation tool, making it easier to observe a higher number of participants.

In the studies where children's views on their outdoor play experiences were explored, a mosaic approach was used to get insight into the views of young children, using arts-based data techniques while interviewing children. These studies were inventive and respected the way young participants are able to express their own views. For example, in the study of Streelasky (2019), drawings, paintings and photographs were used during child interviews to support them in expressing their views. In the study of Moore et al. (2021), the children gave a tour around the yard to express their views on the value of the nature-based environment. Four studies also collected data from teachers, to explore their views and their interaction with children when playing outside in nature-based environments.

Although most studies used open observations to investigate the play activities of the children, some used validated instruments, such as the system for Observing Play and Leisure Activity in Youth (SOPLAY). This system is used by Fjørtoft (2001)

as well as by Dyment & O'Connell (2013) and is a way to label children's activities, for instance to assess the diversity of their activities, but it does not capture how these activities are related to the play environment. Another way to assess the quality of the play activities is in terms of involvement, freedom, and joy. In two studies, the Leuven Child Involvement Scale was used to analyse children's play in terms of involvement and joy. Other studies (Luchs & Fikus, 2013, 2018; Morrissey et al., 2017) used the duration of the play episodes as a measure of the quality of the play: The longer children played, the higher the quality of their play episode.

In three studies instruments were used to assess the play potential of the nature-based outdoor environment. Mårtensson et al. (2009), for example, used the outdoor play environment categories (OPEC) tool, which gives a higher score to environments with large integrated spaces with plentiful greenery and varied topography compared to small areas where open spaces, play structures and vegetation are placed in separate parts of the environment. Richardson & Murray (2016) used the early childhood environment rating scale (ECERS) to assess the nature-based environment, but this tool is developed to assess indoor classrooms and is not adapted for outdoor spaces.

Four of the five studies that also used quantitative data, measured children's physical activity in a quantitative way using accelerometers, and one study measured if features of the natural environment correlated with measures of inattentiveness.

Data analysis techniques were specified in all of the studies. In most of them (24 studies) comparative thematic analysis was used as data analysis technique. In the five mixed method studies, several statistical tests were used as well.

Details about strategies to address validity were not often mentioned, but four of the studies used focus groups of teachers to discuss the finding of the studies and to perform a member check.

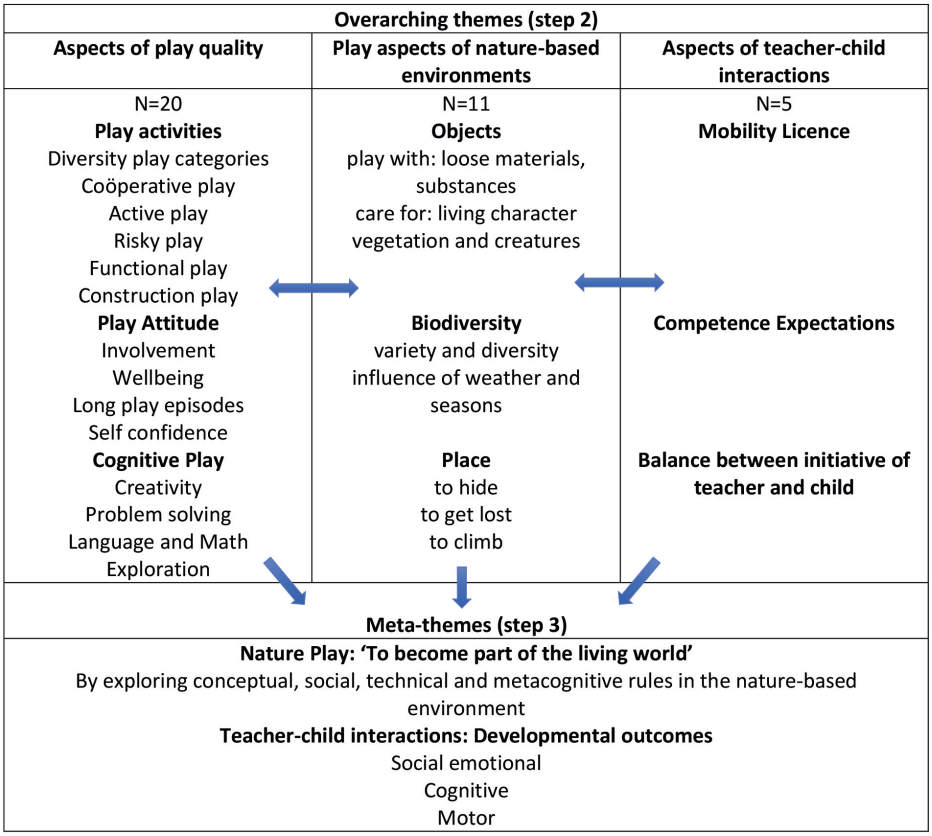


Figure 2.2 *meta-synthesis of key concepts into three Themes and two Meta-themes*

Meta concept and theory analysis

During step 2, we synthesized key concepts in the studies. The studies in this review were selected based on two conceptual criteria, one of them was the *nature-based environment*, the other concept was *play* (or aspects of play). Most studies used a specific theoretical framework and/or a philosophical perspective to explain and understand the expected relation between nature-based environments and play. These theories help us to conceptualize about and generalize the findings within the specific studies and help us to understand the limits of these generalizations.

Play

Seven studies used a specific theory in which the concept of play was embedded. Most of these studies used Vygotsky's sociocultural theory, from which play can be defined as a mode of activity. However, the concept 'activity' was mostly used as 'the things children do' or, in other words, children's actions. Certainly, the theory

was not used to place play in the larger cultural-historical context. Other studies used a criterion- based definition of play, such as it was 'free', or child initiated. For example, in the study of Brussoni et al. (2017) play was described in terms of activities chosen by the children. Different aspects of these activities in nature-based environments were explained, such as hierarchy between peers during play, the complexity of the play or the duration of play episodes. Other studies defined play as consisting of different play categories, some of them cognitively more complex. For example, in the study of Dyment & O'Connell (2013) play was described using five categories: functional, constructive, symbolic, self-focused, and talking, whereas the constructive and symbolic category was also coded as creative and imaginative. In the studies that focused on a specific type of play, such as physical play, risky play, or sociodramatic play, it was easier to extract the specific play concept. Morrissey et al. (2017) for instance, used a detailed description of the concept of sociodramatic play: involving two or more players, providing a crucial everyday context in which children are motivated to engage socially with peers, and practice skills in communication, negotiation, symbolic and creative thinking.

Nature-based environment

Twelve studies used Gibson's affordances theory to distinguish nature-based environments from non-nature-based environments. Lerstrup and Konijnendijk van den Bosch (2017), for instance, used the affordances approach to operationalize how play actions are afforded by a specific feature of the environment and a specific user (a child of the preschool participating in their study) of that feature. In this way, the environment is not viewed as a separate object, but as something children take with them in their own experiences. Sandseter (2009) assessed how a nature-based environment affords risky play for pre-schoolers, using the concept of affordances, but adding the role of the educator to the equation.

Some studies used the concept 'play opportunities' instead of affordances, to operationalize the relation between children's play behaviour and a nature-based environment. Canning (2013), for example, made observation notes of the play behaviour during den-making sessions and focused on the conversations between children to explore how the environment offers opportunities for creative thinking. In the den-making context the nature-based environment is an integrated part of children's play experience in the same way as the environment in the affordances approach. In short, in most of the studies the relation between nature-based and children's play behaviour is operationalized as observed activities afforded by nature-based outdoor environments.

Although all of the studies aimed to explore if and how (aspects of) children's play behaviour is afforded by nature-based outdoor environments, there is no generally accepted description of the concept 'nature-based environment', and it is hardly operationalized in most of the studies. Fourteen studies (appendix 3, Table 1 no. 2, 3,6,8,11,12,14,19,20,23,24,25,27,28) used a comparator outdoor play environment to compare the nature-based environment with. The comparator environment that was referred to as 'traditional' or 'usual', always contained man-made or manufactured elements such as a climbing structure and a sandpit. Another similarity in the description of elements that the non-nature-based environment consisted of was the character of the surface: it was paved, concrete, or hard. This is a kind of surface that afforded functional play: riding bikes, running around. These comparator environments can serve as a starting point to describe the (operationalized) characteristic elements of the nature-based environments in the studies.

In contrast, the elements of the nature-based environment were in the first place described as elements that were not man-made and do change, grow or die (even) without the intervention of humans. For instance, in the study of Brussoni et al. (2017) the 'seven C's system for assessing the quality of the outdoor environment was used. One of the C's stands for change: How does the play environment change over time? Second, although nature-based environments can change, grow or die without human intervention, at the same time the elements of the nature-based environment are more sensitive to human intervention than man-made elements in a non-nature-based environment, for instance a climbing structure. Therefore, nature-based environments ask for care when playing with and in it, which interferes with the children's play actions. Third, the surface of the nature-based environment is referred to as 'biodiverse, soft, diverse'. An example of this is the study of Puhakka et al. (2019). In this study, the greening of day-care yards consisted not only of adding green elements, but also of replacing the complete surface area of a day-care yard by forest floor, sod, peat blocks and planters for vegetable growing, making the surface more biodiverse.

Related to the surface as an important element of the nature-based environment, in many studies natural loose parts found in or on this surface were a vital element of the nature-based environment affording specific play activities. Harwood & Collier (2017) even went a step further by not operationalizing the observed activities of the children afforded by nature-based outdoor environments, but by operationalizing the activities that the natural loose parts performed in the child's play narrative. In this view, the agency of sticks in children's multi modal texts was

afforded by the children. This post-humanist perspective (as they called it) was interesting as it described how the agency of the children was enriched by focusing on the agency of the stick. To acknowledge the agency of nature-based environments might be a key factor in describing the special way it affords play, compared to other environments.

Three studies used a theory of place. These theories account for the fact that a child's identity is nurtured and shaped by place (Adams & Savahl, 2017; Crippen, 2017; Gruenewald, 2003). Children have strong attachments to the places they play in and actively construct places for imaginative play (R. Hart, 1979).

Meta data analysis

In step 3 we compared and contrasted the key concepts found in the studies to one another to establish overarching themes (reciprocal translation). Most of the studies showed that aspects of children's play quality are related to aspects of nature-based environments which might lead to benefits for child development if mediated in certain ways by early childhood educators. However, this relationship is complex, and it is not easy to isolate the elements of the physical environment from all other factors that influence play quality. In order to find how the outcomes of studies were related, we grouped the studies according to (1) aspects of play quality (2) aspects of nature-based environment, (3) aspects of teacher-child interactions.

Theme 1: Aspects of play quality: play actions, play attitude, cognitive play

All studies pointed out that there was a relation between children's play actions and nature-based environments. Firstly, compared to a non-nature-based environment, there was more variety in play categories while children played in nature-based environments. In the studies, a non-nature-based environment mostly afforded a more physical type of play whereas nature-based environments afforded more diversity in type of play. For instance, Luchs & Fikus (2018) observed that children showed play patterns in which they combined different play types. Six studies reported more socio-dramatic play in the nature-based environment. In the study of Coates & Pimlott-Wilson (2019), for example, children reported that the forest site where they played offered them opportunities to make things and be creative, and enact their own stories.

Secondly, the vast majority of the studies reported how play in nature-based environments was related to children's social-emotional attitude during play. Interesting were the studies that included children's own perspectives on their play experiences in nature-based environments: Children often reported joy, wellbeing, enthusiasm. For instance, in the study of Moore et al. (2021) they included 'stories

of agency' in which children demonstrated a strong sense of comfort and self-confidence with the nature-based environment, by telling about the freedom they felt to make footprints anywhere or to cool down in the grass. This sense of confidence was also found in the studies that observed more risky play in nature-based environments, or a higher degree of risk afforded by nature-based environment. In the study of Mcclain & Vandermaas-Peeler (2015), the degree of 'wilderness' of the environment (a creek compared to a river) afforded the degree of challenge and risk in the observed play behaviour. Some studies emphasized the possibility of the nature-based environment to sustain the play story, resulting in longer play episodes, compared to episodes on the non-nature-based playground. But also, in using more play space, as the nature-based environment helped them to meander from one area to another. This relates to the studies that pointed to more explorative play behaviour or higher involvement and engagement during play in nature-based environment. For example, McCree et al. (2018) found high scores of involvement during play sessions on a forest school site.

Thirdly, besides the fact that playing in a nature-based environment interacts with how children play in such an environment, five studies described how this is related to children's cognitive development. In early childhood, cognitive development as an outcome of play activities is highly dependent on how much a child is involved in play and the extent to which the child experiences wellbeing. Seven studies observed explorative play behaviour, problem solving and creativity and related this to the nature-based environment. For example, in the study of Puhakka et al. (2019), increasing biodiversity and the amount of greenery of school yards led to more explorative play, more multi-sensory play experiences, and better pre academic skills (i.e. counting) than before the intervention. In the longitudinal study of McCree et al. (2018) an improvement in academic attainment (i.e. reading, writing, maths) was seen after three years of attending weekly forest school sessions compared to their non-participating peers at school. The study of Richardson & Murray (2016) was the only study that measured richer language use during forest school sessions, in terms of noun diversity, and the use of adjectives and verbs.

To summarise this step of reciprocal translation: when children play in nature-based environments, the quality of their experiences during play experience is improved. This is shown by a greater diversity in play actions while at the same time the duration of the play episode was extended, compared to their play in non-nature-based environments. Children's involvement and wellbeing during play was intensified while playing in nature-based environments. Furthermore, they were not only physical active but also used different cognitive skills in their play.

Theme 2: Play aspects of nature-based environments

Although in theme 1 we showed that playing in nature-based environments relates to higher play quality, it was not yet connected to specific aspects of the nature-based environment. Theme 2 reveals that this higher play quality is connected to specific aspect of the nature-based environment. Most of the studies indicated a clear relation between nature-based environments and playing with loose or fixed natural materials. Playing with loose materials often leads to construction play. For instance, in the study of Puhakka et al. (2019) the researchers observed that children were doing more arts and crafts with the loose natural materials. In many other studies we reviewed, sticks were mentioned as natural materials with special interest. For instance, in Canning's (2013b) study children used sticks to lay out a ladder and to pretend to climb in it. In the study of Harwood & Collier (2017) the sticks even had agency, for instance they were friends carried and cared for by the child, being able to change the play narrative of the child. In four studies play with small creatures was mentioned (e.g., insects, worms, snails), as well as care for plants and vegetation. These studies also pointed to the importance of the notion of abundance of natural materials as opposed to the notion of scarcity (for example of toys) in non-nature-based environments. Zamani (2013) described how the living character of nature-based zones sparked curiosity and wonder, and invited play with critters and plants. Also in the study of Wight et al. (2016) the fact that nature 'lives' made children caring for it. In three studies the notion of place was connected to the possibility to immerse or hide in it, for instance a shrub or high grass, or to offering objects (leaves, sticks) that can be used to transform the space into a place of imagination for sociodramatic play.

Reciprocal translation led us to conclude that when children played in nature-based environments, specific aspects of the nature-based environment, such as the abundance of materials and substances to play with might be connected to quality of children's play activities, which is related to the cognitive outcomes mentioned above. At the same time the nature-based environment owns agency in play, 'it/he/she plays back, nature instigates play.

Theme 3: Teacher-child interactions

In most of the studies in this review, children's play in nature-based environments was child initiated, not teacher led. However, the role of the teacher is part of the children's play environment and in four studies this teacher's role in nature-based environment was specifically investigated (Akpinar & Kandir, 2022; Mackinder, 2017; Mawson, 2014). They found that the role of the teacher influences play quality. In the

study of Mawson (2014) the outcomes of a hands-off approach to teacher child interactions, where children could freely roam throughout the woods, was compared to a hands-on approach with teacher-led activities. These two approaches resulted in differences in child behaviour. In the hands-off approach, children were taking more risk and challenged themselves more and also engaged in more socio-dramatic play, while in the hands-on approach the teacher was directing children's attention towards objects for play and shared more factual information.

It is important to also consider other factors that support possibilities of nature-based environments for children's learning and development. Specifically, including assessments of teachers' perceptions of their children's underachievement, along with their supervisory/teacher style. In the study of Maynard et al. (2013), most of the children in the study that were perceived as 'underachieving', changed their behaviour while playing in a nature-based environment to such extent that this 'underachievement' was not seen anymore. To be outdoors in nature with more space and less constraining by teachers offered the children the opportunity to show differences in social, emotional and learning behaviour, for instance children were more cooperative, showed more pro-social behaviour and remained more on task.

Reciprocal translation led us to conclude that when children play in nature-based environments, the character of the teachers' mediation between children and between children and the environment influences how the affordances of the nature-based environment are actualized in play. When children received greater independent mobility licence from their teachers (Kyttä, 2004) it not only offered more opportunities for risky play, but also for more independence in being creative, explorative and self-confident. Moreover, teacher's mediation itself is impacted by the nature-based environment: the nature-based environment changed their expectations of children's skills and behaviour, which in turn influenced children's independent mobility licence. The more affinity with the nature-based environment teachers had, the more they were able to reinforce children's mobility and agency towards the nature-based environment, by balancing between child initiative and teacher initiative, transferring some of their own initiative to the nature-based environment.

Discussion

Taken together our qualitative synthesis suggests that the affordances for play in nature-based environments experienced by children and teachers are not only different from the affordances for play in non-nature-based environments, which is

obvious, but the affordances of the nature-based environment might also improve the quality of play. This is interesting for ECE teachers, since high quality play will yield children's learning and development (Rubin, Fein, & Vendenberg, 1983). The studies also indicated that the relation between a nature-based environment and play quality is complex. Although the body of research into this topic is growing, more work needs to be done. The qualitative studies reviewed in this article forms a useful complement to the most recent systematic review on this topic from Dankiw Id et al. (2020), which reviewed primarily quantitative studies. Insights from the current review can support our understanding of the meaning of play that is enabled and sustained by the nature-based environment for children in ECE. Taken together, our review gives a first indication of the importance of play in nature-based environments for children's cognitive, social-emotional and motor development.

Qualitative research can thus unravel how children's play and the nature-based environment are mutually constitutive and how play processes are mediated by teachers to support children's cognitive, social-emotional and motor development. Through an interpretation of the synthesis, below we present a 'line of argument' - step 4 in the meta-ethnography - about how nature play can promote child development. We refine parts of play theory, by elaborating on the importance of the distinctive living character of the nature-based environment and its ability to 'play back'. Besides, we will use the affordances theory to reframe the concept 'afforded play actions'. We argue that reciprocity and diversity are unique qualities of nature play, contributing to child development if teachers permit and support children to explore the conceptual, social, technical and metacognitive aspects of the nature-based environment in play.

Line of argument, the value of nature play

Play theories explain how children's active engagement with the surrounding world (i.e. play) results in knowledge of different aspects of the world, while in the meantime they learn to take part in it (Bakhurst, 2009; Piaget, 2013; van Oers, 2013). This qualitative synthesis illuminates the uniqueness of nature-based environments for meaningful play activity which is largely ignored in play theories Firstly the 'living character' of the nature-based environment, the fact that it has a life of its own, accounts for reciprocity and diversity in children's play. Secondly the fact that children use tools (or toys) during play is commonly accounted for in play theories, whereas nature-based environments provide an ample and diverse supply of loose parts(Speldewinde & Campbell, 2022). Which results in creative and imaginative play. Furthermore, both the stress reduction theory (SRT) as well as the attention

restoration theory (ART) account for the special connection between humans and nature-based environments (Adams & Savahl, 2017; Kaplan, 1995; Ulrich, 1983). These theories imply that being in nature contributes to wellbeing, but do not refer to interactions with nature. For children, being in an environment leads to interaction with it, and play theory shows that the quality of these play interactions are important (Burghardt, 2012; Speldewinde & Campbell, 2022). The current synthesis shows that, for children, not only *being* in nature but also *interacting* with nature is important, as they experience that these interactions are reciprocal. Nature has agency in these interactions and is adaptive towards diversity in children's needs. Children listen to and tune into the nature-based environment, for example they gather sticks, pile them up for the imaginative bears to crunch them up during teatime. As such the environment instigates and enriches play.

In line with Gibson's affordances theory, this review acknowledges how play actions are afforded by specific features of the physical environment and a specific user. However, we found that the affordances theory might overlook the complexity of the concept of 'play' as it tends to look at individual play actions afforded by specific environmental features, such as a tree trunk affording jumping off. Using the affordances theory in this way, the attention will automatically be drawn to physical actions. Based on this qualitative synthesis, we argue that nature-based environments afford play activity on a more complex level than physical play actions alone. As we saw in the example of the children serving imaginative bears sticks during teatime, nature affords not only play actions, but also play scripts. The individual play actions are part of play activity that guides children to transform the perceptual world into a conceptual world. Our review indicates that nature-based environments afford the conditions for play, wellbeing and involvement, as well as sociodramatic play and cognitive play, while in the meantime serving as a communicative context for sharing concepts together.

Our line of argument helps us to answer our research question: *what is the value of play in nature-based environments compared to non-nature-based environments for developmental outcomes of young children (2-8 year)?* Our answer lays in defining how nature-based environments afford play in a distinctive way resulting in the concept of 'nature play': 'play in a nature-based environment consisting of natural loose and fixed elements (trees, vegetation water, sand, sticks and stones) where children have the opportunity to engage in activities in which they are highly involved and where they have (some) freedom to develop their own play script, while interacting with and tuning into the affordances of the nature-based environment.

Nature play has outcomes for motor, social-emotional and cognitive development. In nature play, children have the possibility to find out how they are part of a **living** system. Early childhood educators are key actors in how children engage in play in the nature-based environment. They can support them to discover the conceptual, social, technical, and metacognitive aspects of nature-based environments. They need to expand children's independent mobility to encourage them to explore the environment as well as to mediate between the child and the environment.

Strengths and limitations

The strength of this systematic review is that it synthesized the meaning of play in nature-based environments in ECE across qualitative research. It is worth noting that although the synthesized studies were small-scale studies, these studies were particularly respectful to the way children interact with the world and sincerely tried to give voice to the view of these children and their teachers. Nevertheless, small scale studies are often context-specific lacking the scale to 'follow through to the implied logical entailed conclusion' (Nye et al., 2016a). Synthesizing the findings of these studies helps us to present new understandings of our topic, by drawing relationships between the individual studies. We acknowledge that the way we have refined and extended theory is not without its problems. A possible bias in the range and nature of qualitative research synthesised here is that outdoor play in ECE is mostly done for the reason of recess and to relax. For example, the strong emphasis on well-being and physical play in both the experiences of teachers and children, might reflect a western view on outdoor play in nature-based environments. Therefore, the reciprocal translation of the findings around cognitive skills were harder to synthesize although the importance of these findings for ECE should not be underestimated. Certainly, the strength of the meta-ethnographic approach is that it combines findings from multiple sources to increase validity and takes it a step further than primarily providing a narrative review of individual studies. Instead, it develops higher-order explanations. The consistency in the findings of studies in this meta ethnography supported its value, as the studies were undertaken in different educational settings, with nature-based environments varying in size and design. Another limitation is that in our attempt to translate themes across studies to arrive at higher order concepts during 'step 2' of the synthesis, we may have lost some of the meaning and depth of key concepts and themes. However, we sought to preserve individual authors' interpretations in our reciprocal translation of all the key concepts by memoing the key concepts. These memo's contained comments on how the concepts were developed, connecting these concepts into

meta themes, meanwhile we re-aligned our line of argument with the findings of the individual studies.

Future research

This systematic review provides some suggestions for future research. The first promising line for new research would be to include a deep theoretical understanding of play for the development of young children when studying interventions in nature-based environments. Although the affordances theory seems to explain how the environments afford play actions, it is not sufficient to move beyond the individual play actions. From an educational perspective we argue it is important to shift our view of outdoor play from 'letting off steam' to playing in nature-based environments for children's cognitive development.

From a methodological perspective, future research could benefit from the post humanist view in the study of Harwood & Collier (2017). Taking the agency of the nature-based environment in the play of young children seriously, we might find new perspectives on how humans and nature are connected. This is in line with the movement of acknowledging the rights of nature, as was done for the first time with the Te Urewera Act in New Zealand (*Te Urewera Act 2014 No 51, Public Act – New Zealand Legislation*, n.d.). In this act, it is acknowledged that Te Urewera has an identity in and of itself, inspiring people to commit to its care. In a western view of nature-based environments we tend to look mostly at the human perspective of interaction with the nature-based environment, whereas in this synthesis it is clear that children experience nature as something that 'plays back'.

Conclusion

Results of this systematic review using a meta ethnographic approach indicates that playing in nature-based environments not only supports young children's healthy physical development (e.g., physical activity and motor development), but might also support their social emotional, motor, and cognitive development. Although the studies we reviewed were mainly explorative and small-scaled, they do indicate that nature-based environments have far more to offer than only a space to relax or let off steam. Nature-based environments function as a play partner that helps children to transform the perceptual world into a conceptual world, because it diversifies play, is sensory rich and it plays back. When playing in nature-based environments, children have the possibility to connect with it in an interactive way. When teachers know how to mediate children's interactions with the nature-based environment, these interactions will have developmental value. Therefore, we encourage early

childhood teachers to change their practice of playing outdoors into 'nature play' as a daily activity that supports cognitive, social-emotional as well as motor development. Finally, as we have seen the value of nature-based environments for play, in line with Article 31 of the United Nations Convention on the Rights of the Child (UN, 1989) we might even consider nature play as a fundamental need and right of children. A need for and right to play in nature-based environments that needs to be respected in the lives of young children.

Acknowledgments

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Appendix 2.1 *Prisma Checklist*

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			lines
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	15-37 (see also checklist for abstracts)
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	62-73
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	73, 228-256
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	263-272
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	273-313
Search strategy	7	Present the full search strategies for all databases, registers, and websites, including any filters and limits used.	303-313
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	314-330
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	322-340

Section and Topic	Item #	Checklist item	Location where item is reported
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	334-340
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	NA
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	322-330
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	NA
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	365-375 (file 3)
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	NA
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	File 3
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	332-379
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	NA
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	382-450

Section and Topic	Item #	Checklist item	Location where item is reported
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	NA
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	605-629
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	319-320
Study characteristics	17	Cite each included study and present its characteristics.	Table 1
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	JBI quality assessment tool File 2
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	NA
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	NA
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	NA
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	534-651
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	534-651

Section and Topic	Item #	Checklist item	Location where item is reported
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	NA
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	NA
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	682-723
	23b	Discuss any limitations of the evidence included in the review.	721-732; 737-739;
	23c	Discuss any limitations of the review processes used.	746-748
	23d	Discuss implications of the results for practice, policy, and future research.	753-769
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	NA
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	NA
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	NA
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	792-793
Competing interests	26	Declare any competing interests of review authors.	797-798
Availability of data, code, and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Additional files 1,2,3

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372: n71. doi: 10.1136/bmj. n71

Appendix 2.2 *Search query and quality appraisal tool*

Search query:

(AB =(green* NEAR/2 ((((((environment* OR playground*) OR landscape*) OR play-scapes) OR setting) OR area) OR space*)))
OR
(AB= (natur* NEAR/2 (((((environment* OR playground*) OR landscape*) OR play-scapes) OR setting) OR area)))
OR
(AB= (school NEAR/2 ((((garden* OR forest*) OR wetland*) OR wilderness) OR grass-land*)))
OR
(AB=(greenery))
OR
(AB= (garden*))
OR
(AB=(forest*))
OR
(AB= (wetland*))
OR
(AB=(wilderness))
OR
(AB= (grassland*))
OR
(AB= (tree cover))
OR
(AB = (tree canopy))
OR
(AB= (biodiverse school ground))
OR
(AB= (nature-based))
AND
(AB= ("role play"))
OR
(AB= (play NEAR/2(((((pretend OR social) OR imaginative) OR "socio dramat-ic") OR "social pretend") OR "as if ")))
OR
(AB = (play NEAR/2 (((((((manipulat* OR object) OR relation-al) OR block) OR "loose part*") OR outdoor) OR free))))
OR
(AB = (play NEAR/2 (((((((unstructur* OR "rough and tumble") OR explorat*) OR creativ*) OR construct*) OR physical) OR fysical) OR object) OR "gross motor")))

OR
(AB= (activit* NEAR/2 ((((physical OR unstructur*) OR explorat*) OR fysical OR construct *) OR "gross motor")))
NOT AB= ("plays a role")
NOT AB= ("nature of")
AND AB=child*

Quality appraisal tool for qualitative data (Lockwood et al., 2020)

Answers to the questions can be Yes(y) No (n) Unclear (u) or Not Applicable (na)

1. Is there congruity between the stated philosophical perspective and the research methodology?
2. Is there congruity between the research methodology and the research question or objectives?
3. Is there congruity between the research methodology and the methods used to collect data?
4. Is there congruity between the research methodology and the representation and analysis of data?
5. Is there congruity between the research methodology and the interpretation of results?
6. Is there a statement locating the researcher culturally or theoretically?
7. Is the influence of the researcher on the research, and vice- versa, addressed?
8. Are participants, and their voices, adequately represented?

Since the participants in these studies were very young children, we appraised the studies that used creative ways to represent the actual voices of these young children with Y!, in our view this can be viewed as excellent.

9. Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?
10. Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
1. (Akpinar & Kandir, 2022)	u	y	y	y	y	y	n	y	y	y
2. (Blanchet-Cohen & Elliot, 2011)	y	y	y	y	y	y	y	Y!	y	y
3. (Herrington & Brussoni, 2015)	y	y	y	y	y	y	n	u	y	y
4. (Canning, 2013)	y	y	y	y	y	y	y	Y!	y	y

Continued.

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
5. (Coates & Pimlott-Wilson, 2019)	y	y	y	y	y	y	y	Y!	y	y
6. (Dyment & O'Connell, 2013)	u	y	y	y	y	y	y	Y!	y	y
7. (Elliott, 2021)	y	y	y	y	y	y	n	y	y	y
8. (Fjørtoft, 2001)	y	y	y	y	y	y	y	u	y	y
9. (Harwood & Collier, 2017)	y	y	y	y	y	y	y	Y!	y	y
10. (Lerstrup & Konijnendijk van den Bosch, 2017)	y	y	y	y	y	y	y	u	y	y
11. (Luchs & Fikus, 2018)	y	y	y	y	y	y	y	u	y	y
12. (Luchs & Fikus, 2013)	y	y	y	y	y	y	y	u	y	y
13. (Mackinder, 2017)	y	y	y	y	y	y	y	y	y	y
14. (Mårtensson et al., 2009)	y	y	y	y	y	y	n	n	y	y
15. (Mawson, 2014)	y	y	y	y	y	y	y	y	y	y
16. (Maynard et al., 2013)	y	y	y	y	y	y	y	y	y	y
17. (Mcclain & Vandermaas-Peeler, 2015)	y	y	y	y	y	y	y	y	y	y
18. (McCree et al., 2018)	u	y	y	y	y	y	n	Y!	y	y
19. (Moore et al., 2021)	y	y	y	y	y	y	y	Y!	y	y
20. (Morrissey et al., 2017)	y	y	y	y	y	y	y	y	y	y
21. (Norðdahl & Einarsdóttir, 2015)	y	y	y	y	y	y	y	Y!	y	y
22. (Puhakka et al., 2019)	y	y	y	y	y	y	n	y	y	y
23. (Richardson & Murray, 2016)	y	y	y	y	y	y	y	y	y	y
24. Sandseter, Ellen Beate Hansen	y	y	y	y	y	y	n	y	y	y
25. (Storli & Hansen Sandseter, 2019)	y	y	y	y	y	y	n	u	y	y
26. (Streelasky, 2019)	y	y	y	y	y	y	y	Y!	y	y
27. (Wight et al., 2016)	y	y	y	y	y	y	y	y	y	y
28. (Zamani, 2016)	y	y	y	y	y	y	y	Y!	y	y

Appendix 2.3 Meta Method Extraction

Table 2.1

Study	Research Aim	Theoretical/ philosophical perspective	Sample characteristics	Data collection
1.(Akpinar & Kandir, 2022)	To investigate preschool teacher's views on outdoor activities	Not specified	N = 63 preschool teachers (from all regions in Turkey).	Interviews, semi structured with 63 Turkish preschool teachers, on their views of outdoor play.
2. (Blanchet-Cohen & Elliot, 2011)	Describe how young children and educators actively engage outdoors.	Right based, children's right Attention Restoration (ART)	N=12 (1-5 year), 4 early childhood centres, only specified N (Canada)	Multisite Case Study with participatory observation, videotapes, notes to measure children's play when playing outside. Focus groups with educators.

Data analysis	Results/Main Outcomes
Thematic analysis of the interviews resulting in 9 themes.	1. Teacher's frequency of allocating time for outdoor play in their program 2. Teachers' views regarding reasons for not making time of making less time for outdoor activities in the program: The weather is huge factor in the decision whether to go play outside or not. Not only teachers but parents as well are concerned about getting sick in cold weather. 3. Teachers' views regarding the time they allocate to outdoor play activities in the program. 4. Teachers' views regarding time preference for outdoor play activities. 5. Teachers' views on their planning styles of outdoor play activities in the program: Teachers would like to spend more time outdoors. Most of the teachers suggested that an improvement of the physical conditions of the playground, more clear educational policies on the benefits of outdoor play for children, and support of school management would make them spend more time in the outdoors. 6. Teachers' views on the ways of directing outdoor play activities in the program: They plan activities and have room for free play. 7. Teachers' views on the effect of outdoor play activities on development. 8. Teachers' views on the effect of outdoor play activities on other activities. Most teachers in the study view outdoor play to be beneficent for social-emotional, physical and cognitive development.
Thematic analysis of focus groups reflection process on incorporating natural environments as alternatives to usual playground structures. Reflection process with children and educators.	eagerness, enthusiasm, joy, focus involvement of senses, physical movement including of natural elements in play engagement with living creatures, entertainment and discovery learning about circularity, cycles of more cooperative play, collaboration problem solving

Table 2.1 *(continued)*

Study	Research Aim	Theoretical/ philosophical perspective	Sample characteristics	Data collection
3. (Herrington & Brussoni, 2015)	To investigate the effect of a Seven C's design: (character, context, connectivity, clarity, change, challenge) to increase access to nature and risky play opportunities (highest quality play spaces: scaled to the child, sensitive to climate, include living materials, and elements that children can manipulate, and spaces for individual and group play	Affordances theory	N=45 children (2-5 year), 2 centres (Canada)	Intervention study, repeated measures mixed methods design, measuring the change in play behaviour with: questionnaires sociometric status SDQ, PSBS accelerometers play observations spatial behaviour maps ECE focus groups. Redesigning outdoor space by adding natural materials to enhance affordances for play
4. (Canning, 2013)	To explore opportunities for creative thinking and imagination through den making, how do children use play space and resources to sustain imagination and creativity.	Cultural Historical Activity Theory (CHAT)	N=5 (3-4 year) (UK)	play observations, field notes on conversations of children, during den making sessions. Play observations on a woodland area.
5. (Coates & Pimlott-Wilson, 2019)	To investigate how children interpret their learning experiences while engaging in forest school setting.	Constructivist, CHAT	N=33 (4-8 year), 2 schools (UK)	Semi structured interviews with children on their experience of classroom learning compared to outdoor engagement in Forest School to generate understanding about the meaning of these experiences. Comparing classroom learning with forest school programme

Data analysis	Results/Main Outcomes
Comparative analysis T1 and T2	Decrease in: depressed affect, antisocial behaviour and moderate to vigorous physical activity. Increase in: play with natural materials, independent play and prosocial behaviours
Thematic analysis	Using sticks for a ladder, using environment and the resources to keep it going, allowing children to go with their imagination, you can leave the materials where they are. Sustain the story, and creativity. Problem solving thinking through what they mean.
Phenomenological thematic analysis	break from routine no pressure, no stress, refreshed, playful learning through play being creative kinaesthetic, experiential learning, making things, story-based learning, child directed play in FS being physically active learning about the environment, navigate challenging environment, managed risk collaboration and teamwork the opportunity to experience a change in social boundaries

Table 2.1 *(continued)*

Study	Research Aim	Theoretical/ philosophical perspective	Sample characteristics	Data collection
6. (Dyment & O'Connell, 2013)	To investigate if play design influences where and how children play on preschool playgrounds.	Not specified	N=100, (1-5 year) 4 schools, 4 playgrounds (Australia)	Observation of play of play on differently designed target areas of different designed outdoor spaces: paths, paved places, manufactured equipment, soft falls, natural areas, sand pits using scans with SOPLAY
7. (Elliott, 2021)	To examines the ways in which children use the garden in different seasons and to discuss factors, such as the weather and the adults in the setting, that affect their play alongside the affordance of outdoor resources available to them.	Reilly's play theory Affordances theory	N=50, early childhood setting with a garden (UK)	Observation of play of 50 children, during observation field notes were made, with notes on the weather circumstances. Also, pictures were made of play activities.
8. (Fjørtoft, 2001)	To investigate how children's play in the natural environment might stimulate their motor fitness, by focusing on the affordances of the landscape and the correlation with versatile play.	Affordances theory	N=75 (Norway)	Measuring children's motor fitness after a nine-month period of play on two different outdoor environments: a forest and a fenced outdoor space. Pre- and post-test with EUROFIT test for motor fitness. Comparing play in forest nearby kindergarten with play on traditional playground

Data analysis	Results/Main Outcomes
Comparative analysis	Paved area's: mostly functional play, chosen when there's is no alternative Softfall and grass: functional play, self-focused: popular choice Sand features: for constructive and symbolic play, chosen if there is no natural alternative Manufactured, constructions: popular choice for symbolic and functional play depending on type of equipment Natural area's: even if small popular choice functional and constructive play that was creative an imaginative
Thematic analysis, with focus group and children	There is a strong connection between the resources available to children in their play, the other players (including adults and their role in the play) and the seasonal changes in the weather. Children needed more encouragement of adults when it was cold. But when outside they modify and adapt resources according to their needs. Having a choice, makes children to spend more time outdoors. Adults are likely to make choices according to the weather circumstances, while children choose to go outside anyways, and adapt their play to the circumstances. The nature and space of the outdoor environment makes it possible to practice skills in a different way than indoors.
Multiple regression analysis	Structures and affordances for play and the impact on motor development in children. Significant relationship between diversity of the landscape and the affordance of play. Landscape might have a functional impact on children's play behaviour. This impacted the motor fitness. Pre-test and post-test improvement on all elements in the experimental group. Balance and coordination improved significantly.

Table 2.1 *(continued)*

Study	Research Aim	Theoretical/ philosophical perspective	Sample characteristics	Data collection
9. (Harwood & Collier, 2017)	To observe and document intra-active and improvisational entanglements with the forest as a more than human world.	Post humanist	N=8 (2-4year) (Canada)	Thing-matter-energy-child assemblages, while playing in forest during Forest School sessions. Data collected with: notebooks, iPads, Go-Pro cameras. Exploring play in forest school site
10. (Lerstrup & Konijnendijk van den Bosch, 2017)	aim: a practical way to describe and classify outdoor settings for children's self-initiated activities in preschool, with affordances as the synthesising concept which terms are appropriate for analysing and understanding affordances of outdoor settings for children in preschool.	Affordances theory	N=49, 2 schools' traditional playground, forest play space (Denmark)	observation of meaningful activities and environmental features that seemed to be of value during children's play in two different outdoor environments: a forest and a traditional playground, using video recordings and field notes. Comparing traditional playground with forest nearby preschool
11. (Luchs & Fikus, 2018)	Revealing the impact of different playground environments on the locomotive activity, the range of activity levels during free play. To consider if kindergarten environments should be more diverse, incorporating both elements and structures of natural and contemporary playgrounds.	Affordances theory	N=17 (5-7year) (Germany)	measures of children's locomotive activity in two different designed playgrounds: a natural playground and a traditional playground, using pedometers. Comparing contemporary playground with park

Data analysis	Results/Main Outcomes
Thematic analysis, post humanist theorizing	The sticks were 1. non-representational aspects of children's play, substitutions for the real thing 2. embodied, entangled within the children's play, beyond representation 3. agents, the agency becomes entangled within the agency of the agency of the children4 4. Changed the dynamics of the play with their presence 5. vibrant an actant 6. entangled with the child, child and stick are vial tot the production of something created Independent role of nature, agency of sticks
Comparative analysis of activities that seemed 'no matter' and features that seemed to be of value	5 affording features, 8 functional affordances, places: Open ground, sloping terrain, shielded places: run drive walk/ roll slide, clamber/ hide as a frame attached objects, Rigid or moving fixtures: climb balance, jump/ swing sway, seesaw, spin detached objects, loose objects: Arrange, modify as tools, props, treasures substances, loose materials, water: dig, move, mould, smear/pour mix, splash, float (new) events, creatures and fire: look for, handle care/ feed, look after, sit by
Comparative analysis	gait cycles pm: natural: 25, SD=4.99, min:16.59, max:35,41 contemporary: 28,55. SD=9,60, min 6,82, max:51,00 More gait cycles in contemporary, but also greater SD. Distribution of differences during the whole play episode is different between natural and contemporary. In natural play area not only active children are activated, but also less active children find opportunities to be active. Natural environment

Table 2.1 *(continued)*

Study	Research Aim	Theoretical/ philosophical perspective	Sample characteristics	Data collection
12. (Luchs & Fikus, 2013)	To explore the impact of different designed playgrounds on the play behaviour of children a. detailing number of play episodes b. occurrence of the different categories of play c. duration of the play episodes d. patterns of the play episodes.	Play theory (Frost) Affordance theory Loose parts	N=59 (5-6year) (Germany)	Observation of two different designed playgrounds: a natural playground and a traditional playground. Measures: Number of play episodes Occurrence of different play categories play with, play as, play for, Duration of play episodes Patterns of play episodes. Comparing contemporary playground with park
13. (Mackinder, 2017)	To explore the involvement of children and the participation of adults in Forest School sessions alongside investigation of how sessions are planned.	Forest School approach	N=1 case study 1 child and two teachers (UK)	Observations, field notes, audio recordings of children's play of two forest school sessions with two different ECE teachers using Leuven Child Involvement Scale and Adult participation Scale for adults. Exploring movements on forest school site

Data analysis	Results/Main Outcomes
Comparative analysis	Naturally structured playground: play episodes are longer, sometimes 1 episode for 30 minutes. Suggesting a high degree of concentration, less play with and play for, more combination patterns: more combination of categories. Contemporary playground: episodes are never longer than 15 minutes.
Comparative analysis of teacher style on child behaviour	Eve scores higher on autonomy, sensitivity and stimulation. Eve was full of energy motivation positive, full of praise, caring, allowing for the child's experimentation and exploration. Gill was caring and affectionate, but it was coupled with dominating and authoritative behaviour. In the interview, Eve talked about deep learning, and Gill more about boundaries. planning styles: initially it seemed that there was difference in planning style, but in practice it appeared to be both adult led. Tracking map showed how the child explored more autonomously in Eve's session. Eve was more trained in forest school practice than Gill was. (training amplifies the added value of nature, mobility licence is greater)

Table 2.1 *(continued)*

Study	Research Aim	Theoretical/ philosophical perspective	Sample characteristics	Data collection
14. (Mårtensson et al., 2009)	To investigate if the attention of preschool children is related to outdoor environments, with different play potentials, assesses by OPEC score. If the attention of preschool children is related to outdoor environment with different proximity between natural elements and play structures, assessed by sky view factor.	Attention Restoration (ART)	N=198 (4-6 year) (Sweden)	Observations of children's inattentive, hyperactive and impulsive behaviour using ECCADES tool in different outdoor play environments differences assessed with OPEC. Comparing differently designed playgrounds, assessed with ECCADES tool.
15. (Mawson, 2014)	To explore how teachers views and interaction with the wildwoods influences the way children interact with it.	Affordances theory Theory of place (Tovey)	N=16 (New Zealand)	Observation of teacher-child interactions during children's free play within a wilderness outdoor setting, field notes, interviews with teachers, and photographs. Exploring interactions in a wooded area

Data analysis	Results/Main Outcomes
Statistical analysis, correlation between OPEC score and ECCADES outcomes	High OPEC score relates significantly with inattention, close to significant with hyperactivity and impulsivity. (these factors were also impacted by mother's education, children's outdoor time on Sundays and outdoor fraction, and if child is content with preschool) No relation with sky view factor. Long outdoor stay seemed to be negatively related to attention, but only for preschools that were outdoors all day.
Thematic analysis	Environment contained variety in affordances with multiple play opportunities. Teacher interactions could be placed on an continuum that leaved children to freely roam throughout the woods, just checking on their safety, to very teacher-lead activities. Hands-on approach: direct attention to objects, more factual information, which was used afterwards to be able to do it their selves afterwards (finding the right marshmallow sticks) more complex activities Hands-off approach: more opportunities for taking risks and physically challenging themselves and to draw the teacher's attention. More physically challenging play and more sociodramatic play, but the themes were not shaped by the environment. (mobility licence and guidance)

Table 2.1 *(continued)*

Study	Research Aim	Theoretical/ philosophical perspective	Sample characteristics	Data collection
16. (Maynard et al., 2013)	to find out whether child-initiated learning outdoors did have any effect on children who were perceived by their teachers to be 'underachieving 'and if so, the extent nature and possible reason for this effect.	Reggio Emilia Approach, child-initiated learning	N=48, (4-7year) 8 teachers, (UK)	interviews with teachers, field notes of key issues and insights, reflective journals, final project report of participants on their view of children's learning competence during child initiated outdoor play. Comparing green outdoor spaces with indoor settings
17. (Mcclain & Vandermaas-Peeler, 2015)	To explore in which ways two natural environments influence pre-schooler's physical and socioemotional development, including ways they interacted with various environmental affordances and their peers.	Affordances theory	N=11(2-5year) (US)	Observations of children's play in two different outdoor environments; a creek and a river, using videotapes Comparing two nature-based environments that differed in 'wildness'

Data analysis	Results/Main Outcomes
Comparative thematic analysis	28 of the children acted better in child-led activities. 10 in the social and 9 in the emotional 9 in learning domain 17 children about whom teachers did not make any specific judgements in their final project reports. They tended to comment more generally on observed differences 3 children did not show any positive difference in behaviour, they had multiple severe difficulties, either developmental or challenging home circumstances reasons for observed differences: To be outdoors calm some children down, where there is more space and less constraint by teachers Child initiated learning Changing perceptions of underachievement
Comparative analysis two environments	Creek: flat surfaces: 27%, mostly afforded running, hiding, balancing, jumping off River: 16 % mostly afforded running and hiding, but also balancing, climbing, jumping. Emotions at creek and river mostly neutral/positive. Personal challenges: River more challenges than creek, mostly in climbable or water affordances Relation between affordance and physical and play behaviour, the wilder environment(river) afforded more risk which results in the development of confidence in the face of risk

Table 2.1 *(continued)*

Study	Research Aim	Theoretical/ philosophical perspective	Sample characteristics	Data collection
18. (McCree et al., 2018)	To explore the impact of forest school attending on academic attainment, wellbeing and connection to nature. What are the significant changes over the longitudinal span of the project?	Not specified	N=11 (5-7 year Longitudinal 3 years (UK)	Wellbeing involvement and engagement measured with Leuven involvements scale. Connection to nature measured with Connection to nature index. Academic attainment and attendance measured with teacher's assessments of reading writing and maths. Child interviews, case studies, questionnaires for staff and parents to find themes. Comparing attending forest school programme with children that did not attend the programme
19. (Moore et al., 2021)	to explore children's perspectives on and states of wellbeing while playing, revealed in their story telling, while playing in two different outdoor play environments	Theory of place (Grünewald) Play theory (Huizinga)	N=30 (4-5year) (Australia)	mosaic approach in two centres with different outdoor environments: one with manmade equipment, limited natural surfaces and vegetation one with a playground containing more natural elements and also access to a community garden: Drawings of elements in outdoor play space, Direct tour and photograph important elements Collections of artefacts from outdoor play space into 'memory box' Creating maps of important outdoor play spaces using collected artefacts and photo's Position wishing stones in particular space and re-imagine that space Comparing differently designed outdoor spaces

Data analysis	Results/Main Outcomes
Comparative thematic analysis	Wellbeing, involvement and engagement: high scores, over three years Nature connection: higher in study group compared to average in national survey Academic attainment and attendance: reading, writing and maths, higher improvement than control group
Comparative thematic analysis	Stories of agency, stories of place and attachment, stories of hiding Agency: wellbeing includes the notion of self-confidence and a sense of feeling capable. Relation between positive outcomes and combination of traditional playground equipment with natural elements. Widespread areas of natural shade, provided by trees. Not crowded. Abundance of loose materials, lot of secluded areas.

Table 2.1 *(continued)*

Study	Research Aim	Theoretical/ philosophical perspective	Sample characteristics	Data collection
20. (Morrissey et al., 2017)	To explore the potential influence of the nature of the outdoor play space and associated resources on children's enactment of sociodramatic play processes,	Cultural Historical Activity Theory (CHAT) Affordances theory	N=28 (4-5year) (Australia)	Event sampling of play episodes in two different designed outdoor environments: yard 1: a traditional space with manmade equipment and a naturalised play space defined by natural features such as shrubs, logs, rocks, plants. Comparing a traditional outdoor space with a highly naturalized one
21. (Norðdahl & Einarsdóttir, 2015)	To explore children's preferences about outdoor activities and surroundings in the outdoor school environment	Affordances theory	N=8 (4-5 year) N=8(7-9 year) (Iceland)	interviews, walking tours conversations with children's, meetings with teachers, classroom observations. Comparing differently designed playgrounds
22. (Puhakka et al., 2019)	To explore how simultaneously increasing biodiversity exposure and greening yards, is perceived to affect 3–5-year-old children's physical activity and play, their environmental relationships, and their wellbeing in the urban environment in Finland.	Affordances theory	N=? (Finland)	Interviews with 12 daycare givers and a survey with the 12 daycare givers and 49 parents on possible changes that took place after greening of the yards.

Data analysis	Results/Main Outcomes
Comparative analysis	More sociodramatic play in natural yard in minutes, episodes persisted longer. With lesser children, children spent more time in natural yard. Children in natural yard were less likely to confine their play episodes to one or two areas. In natural yard sociodramatic play was more likely to integrate physical movement. Fantasy roles more likely in natural yard and more domestic roles in traditional yard.
Thematic analysis	Physical challenge Explore things Be in contact with others Enjoy beautiful things
Qualitative content analysis	Functional affordances: Physical activity, multi-sensory experiences, diverse play, arts and crafts, nature exploration, pre-academic skills. Embodied experiences: increase in physical activity and diversification of activity. Involvement: more creative play and imaginative role-playing. They also were looking after the plants and vegetation. Exploration: Increase in self-guided exploration and exploratory play.

Table 2.1 *(continued)*

Study	Research Aim	Theoretical/ philosophical perspective	Sample characteristics	Data collection
23. (Richardson & Murray, 2016)	To explore if there are links between the environment and the quality of young children's utterances as part of their speech and language development.	Theory of language construction, Tomasello	N=4 (3-5year) (UK)	Multiple case study, measuring language reasoning element with TTR (type token ratio) in two different outdoor environments rated with the ECERS scale: the outdoor classroom and a forest school site. Comparing traditional outdoor classroom with forest school site
24. Sandseter, Ellen Beate Hansen	To explore qualitatively the affordances for risky play of two environments, the potential of both playgrounds will be evaluated for children's mobility license and actualized affordances, how different environmental features afford risky play and how these affordances are actualized in children's play.	Affordances theory	N=29 (4-5year) (Norway)	Observation of play behaviour in two different outdoor environments: an ordinary 'fixed' playground and a forest. Interviews with the children on categories of risky play: play with: Heights, Speed, Dangerous tools, Dangerous elements, Rough and tumble play, Disappear/get lost. Comparing traditional playground and nature preschool site
25. (Storli & Hansen Sandseter, 2019)	To find out how two different play environments influence activity levels of preschool children	Affordances theory	N= 16 (3-5 year) (Norway)	Play observations in two different play environments: the preschool's playground in winter and spring, and a nature excursion in spring. Observation of main group activities, related to different environment features and individual activities related to physically active play, which was also measured by accelerometers. Comparing traditional playground with natural playground

Data analysis	Results/Main Outcomes
Qualitative content analysis, Type-Token Ratio analysis	TTR: verb use higher in the natural environment for all children. Exclamation usage and adjective usage was higher for three of four children. Noun usage was higher in classroom for two children compared to forest school. Thematic analysis: semantics were highly connected with the environment. ECERS was lower in natural setting but diversity in language was higher. increased action focus in natural environment might elicit more verb use. More adjective onomatopoeic, connected to more sensory richness. More physicality of the natural environment might promote children's communication. More exclamation, greater freedom to express themselves. lesser diversity in noun use can be related to a higher involvement in one activity with a limited number of objects, not flitting between experiences and encountering al lot of objects.
Content analysis using potential and actualized affordances	Ordinary preschool: potential affordances, actualized affordances: great heights and great speed mobility licence: extensive Natural preschool: potential affordances and actualized affordances: great heights, great speed, mobility license: extensive Difference: disappear/ get lost only in nature. Nature afforded risky play of higher degree of risk
Comparative statistical analysis. Analysis of actualized affordances	Children have the same activity levels in both play environments. standard deviation was less in the measurements of the natural environment. strong correlation physical activity level and individual The lowest activity levels were measured in the traditional playground, it seemed that there was more boredom in the traditional playground for the older children. influence of environmental conditions that change that transform environmental features temporarily

Table 2.1 *(continued)*

Study	Research Aim	Theoretical/ philosophical perspective	Sample characteristics	Data collection
26. (Streelasky, 2019)	To explore what learning experiences do children value at school? What modes are they choosing to express and represent their valued school learning experiences? Exploring play in a forest	Play narrative theory (Bhaktin)	N= 15 (5-6 year) (Canada)	Play observations during play in the indoor classroom setting and a large, forested area close to the school. 2 semi-structured interviews with every student. Multi model participation: photography, painting and drawing and in writing in journals and reading levelled books. Comparing traditional playground with natural playground
27. (Wight et al., 2016)	To investigate what the difference is between pre-schoolers playing on a traditional playground and in nature when it comes to fostering inquiry and exploration as a prerequisite to environmentally responsible behaviours.	Play theory (Piaget)	N=64 (3-5 year) (USA)	Play observations of three visits to a playscape: a large, fenced area, containing large amounts of natural elements such as a forest, wetlands, stream, rock formation and more, using videotapes. Comparing traditional playground with playscape
28. (Zamani, 2016)	To explore how children and early childhood teachers view the cognitive play opportunities in outdoor preschool ones with different proportions of natural settings, how can you compare these settings?	Play theory (Rubin)	N=58 (4-5year) (USA)	Children made drawings and chose photographs of places where they liked to play. Then they were interviewed to explain their preferences. Interviews with teachers on outdoor spaces as a learning environment. Behaviour mapping observations Comparing play on natural, mixed and manufactured and zones of an outdoor preschool

Data analysis	Results/Main Outcomes
Narrative analysis, image-based analysis, thematic content analysis	Majority of the children shared stories about the value they placed on their outdoor experiences. They valued being outside with their peers and with nature. The narratives revealed that children conceptualise themselves there as social beings, and the data provided some insight into the strong sense of autonomy they felt when they were engaged in collaborative outdoor play.
Thematic analysis using codes for levels of inquiry: observation, exploration, representing and recording, language, functional play, constructive play, dramatic play, games	Playscape: Area of Interest (AOI) 42,7% water and 33,6% woods functional play:61,8% constructive play: 26,4 dramatic play 11,8% Science inquiry: observation 34,5%, exploration 43% representation: 5,2%, science specific language: 17,3 % (naming plants and animals and life concepts) Playground AOI: sandpit, activity area 1(corn shucking) and 2: bubble blowing station and bike track. sandpit: 50,3%, activity 1: 40,7%, activity 2:3,8% play behaviour: functional 42,4 %, constructive: 55,2% dramatic: 2,3 % Inquiry related: observations: 39,6 % explorations 46,3% science specific language: 14% More diversity in AOI playscape, more science inquiry (specially representing and language in playscape, playscape fostered more Environmental responsible behaviours
Thematic content analysis	Children: preference for functional play, explorative play in nature, dramatic play, and games in the natural zone, loose parts for cognitive play. Teachers: value of outdoor for learning, learning capacity for of natural zones. Outdoor space is an extension of indoor curriculum to develop social physical and cognitive experience. Each zone has different capacity to support a certain part of development. Nature area offered higher levels of cognitive play, twice as much constructive and the most exploratory and dramatic play. Loose and maliabe parts supported these types of play. Exploratory experiences stimulate children's scientific curiosity to create realistic theories about the world.

3

The importance of play in natural environments for children's language development: An explorative study in early childhood education

This chapter is based on:
Prins, J., van der Wilt, F., van Santen, S., van der Veen, C., & Hovinga, D. (2023). The importance of play in natural environments for children's language development: an explorative study in early childhood education. *International Journal of Early Years Education*, *31*(2), 450–466.
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Abstract

Playing in natural environments is a popular activity for young children. In previous years, studies have shown benefits of playing in natural environment for children's motor development and attention restoration. In this study, we explored the relation between playing in natural environments and children's language use. A total of *N* = 18 children (4-7 years) from three Dutch primary schools participated. To measure children's language use during outdoor play, we recorded their utterances for ten minutes while playing in a non-nature-based playground and a nature-based playground. Audio tapes were transcribed and coded using a coding scheme focusing on communicative functions. Findings indicated that children used more language and more complex language while playing in the nature-based playground. Additionally, four themes were identified: (1) Children used language to refer to their play situation, (2) Children used language to refer to the elements of their physical play environment. (3) Compared to the non-nature-based playground, children talked more about the objects of the nature-based playground, and (4) children talked more about science and math concepts. Play in the nature-based playground appeared to be a richer conversational setting for language use than the non-nature-based playground, with a potential to scaffold and guide language use.

Introduction

Language development is a complex process which is dependent on several mechanisms that are partly intrinsic to the child (e.g., the capacity to share attention and to learn linguistic patterns) and partly extrinsic to the child (e.g., the context in which language is learned), and these mechanisms interact with each other (Smith, 2013; Tomasello, 2003). Schools are one of the many contexts where language is learned and children's language development benefits from attending school (Hoff, 2006). Schools provide children with conversational settings for practicing various language functions, such as to analyse, to reflect, to reason and to justify, to reach their communicative goals. As such, schools provide a rich language learning environment (Hoff, 2006). A rich language learning environment is informed by physical characteristics such as materials that encourage creativity, problem solving and that can function as tools for play (Ellis, 2004; Justice, 2004; Van Oers, 1998).

In recent years, the physical characteristics of the outdoor environment around (pre)schools have been studied widely. Research has shown that play within nature (i.e., forest, green spaces, parks, gardens) with natural elements (e.g., vegetation, rocks, mud, sand or water) has many benefits for children's development (e.g., their motor development, play skills and attention restoration; Dankiw et al. 2020). In natural environments, children play and move in different ways than they do in non-nature-based paved playgrounds (Dyment & O'Connell, 2013; A. F. Taylor et al., 1998). In fact, Kounin and Sherman (1979) claimed that "what people do is markedly influenced by where they are". While previous studies have shown that playing in a natural environment promotes a healthy motor development, diverse play behaviour and attention restoration, this study was designed to explore the relation between language use and playing in natural environments.

Developmental benefits of playing in natural environments for young children

Natural environments provide a context that contributes to children's general wellbeing, health and their cognitive functioning (Dankiw et al., 2020). Although a clear definition of natural environments is lacking, it is generally assumed that nature-based playgrounds contain elements, such as vegetation and loose parts (sticks, trees, stones,) that offer children play and learning experiences that differ from non-nature-based playgrounds with a paved surface and manufactured play elements, such as a climbing structure and a sandpit. Many researchers have studied the impact of the characteristics of nature-based playgrounds on the quality of young children's play (Kuh et al. 2013; Luchs and Fikus 2013; Fjørtoft 2004). Kuh et al.

(2013), for example, found that the nature-based playground had a significant effect on attracting and maintaining children's attention in several types of play, such as constructive and motor play. Research has also indicated that play episodes in nature-based playgrounds have a longer duration, and are more complex and diverse (Luchs and Fikus 2013; Kuh et al. 2013). Young children themselves prefer playing in nature-based playgrounds, mentioning nature's affordances as sensory-rich ('you can watch birds', 'grass is soft' and 'the sun is warm') and contributing to their comfort and wellbeing (Cooke et al., 2020). Furthermore, Richardson and Murray (2016) investigated the relationship between language use and the quality of the physical environment of early childhood settings and found a relation between the richness of the language used and the characteristics of play in the nature-based playground of the forest school. Another correlation between language use and a nature-based environment was found by Cameron-Faulkner et al. (2017) showing that the direct experience of nature (being in a botanical garden) compared to indirect experience (photos and books of nature elements, resulted in an wider range of nature words during parent child talk).

Theories on the relation between the environment and children's language development

First, according to Tomasello's (2003) usage-based language approach, three social-cognitive skills enable children to learn to use language: (1) joint attention (the skill to share and follow other's attention on objects and events, (2) intention reading (the skill to understand others' communicative intentions), and (3) cultural learning (the skill to imitate others). These three skills make it possible to learn lexical labels and to discover grammatical patterns while using language. A natural environment might have a positive influence on the use of these skills. Cameron-Faulkner et al. (2018) for example, suggested that natural environments might promote greater levels of attention between individuals, and thereby influence how people understand each other's communicative intentions. The understanding of communicative intentions is the heart of the language acquisition process, in Tomasello's approach.

Second, in the cultural-historical activity theory (based in the work of Leont'ev and Vygotsky), tool use is an important part of the socio-cultural environment (van Oers, 2013; Van Oers, 1998). A natural environment offers many natural elements (e.g., sticks and stones) that can be used as a tool. While playing with these natural objects, children need to use language to communicate the meaning they attribute to these objects which might, in turn, support their language development.

Third, Gibson (1986; 2014) described aspects of the physical environment as affordances that invite and challenge children to interact with and explore, providing play and learning experiences that are tailored to the abilities of the child. For example: A tree affords climbing for a four-year-old who can climb, but not for a one-year-old, who just learned to walk. According to Heft (1988), the functional possibilities for meaningful play that children perceive in natural environments are different from the possibilities they perceive in non-natural environments. That is, in contrast to play elements of a non-nature-based playground (such as a sandpit with shovels, bikes, and a ball), the objects and materials found in a nature-based playground (such as sticks, feathers, shrubs and acorns) do not have an intentional meaning. Based on Gibson's theory, we expect that the affordances of a nature-based playground would not only impact children's play quality but might as well impact the quality of their language use. Specifically, children must discuss and negotiate how (open ended) objects in nature are going to be used for play. For instance, before a child can use the 'house function' of a shrub, (s)he needs to explore it, which might result in the use of spatial and temporal terms. In addition, to be able to play house in the shrub with a playmate, the child also needs to share the meaning (s)he added to the shrub and to agree on this new functionality. Hence, the conversational setting for playing house in a shrub differs from playing house in a playhouse.

In this study we explored the relation between playing in a natural environment and language use, by comparing play on a non-nature-based playground and a nature-based playground. Based on Tomasello's usage-based approach to language acquisition, the cultural- historical activity approach based in the work of Leont'ev and Vygotsky, and the affordances theory of Gibson, we expected that the affordances of the physical environment influence children's language use and meaning-making during play. In addition, we expected that children would interact more with the natural environment and negotiate more about the meaning of objects and materials, because nature is a more dynamic and open-ended environment compared to a non-natural environment. Finally, we expected that the sensory richness of the natural environment would play a role in children's activities and therefore in the language they used.

Methods

Research context

This study was conducted at three Dutch primary schools (A, B, C), which were located in highly urbanized areas and worked with mixed age groups (4–7-year-

olds) in the first two or three years of primary school. In the Netherlands, primary school children usually play outside for at least one hour per day. The playgrounds of the three participating schools were paved and had a climbing structure and a sandpit (non-nature-based playground). School A and B did not have a natural environment for playing outside. Therefore, approximately twice a month, children at these schools played at a nearby park with shrubs, trees, a grassy lawn, and loose natural objects such as sticks, and stones (nature-based-playground). School C had a school garden next to their non-nature-based playground. This garden contained shrubs, trees, and garden boxes at the sides, and the surface was covered with wood chips. School C played weekly in this school garden (nature-based playground).

Participants

A total of *N* = 18 children (ten boys) aged from four to seven years (*M* = 5;10, *SD* = 1.2) from three schools participated in this study. Outcomes of the Dutch language screening instrument *Spreek Normen Eerste Lijn* (Speech Norms Primary Healthcare; Luinge, Post & Goorhuis-Brouwer 2007) indicated that children had no language impairments. For most children, Dutch was their home language; four children spoke a non-Dutch language at home.

Measures

Language use. Children's speech was audio recorded for 10 minutes to measure their language use during outdoor play in two conditions: (1) non-nature-based playground (the schools' paved playgrounds, containing a climbing structure and a sandpit) and (2) nature-based playground (nature-based park or school garden, containing natural elements and objects (e.g., vegetation, shrubs, and loose elements such as sticks and rocks). The children wore safety vests ('play jackets') with a pocket containing either a portable voice recorder (participating children) or an imitation voice recorder (children's classmates). All children wore the vests over their coats during outdoor play. In total, 36 ten-minute audio recordings were collected (one per condition for each child).

Play activities. Participating children were systematically observed by trained research assistants during outdoor play. The assistants reported their observations of children's play activities in real time using a voice recorder.

Procedure

The present study was part of a larger research project for which ethical approval was obtained from the ethical committee of the Authors' University (details removed for blind review). Schools were recruited through the professional network of the first

author. We obtained informed consent of the legal representatives of the participating children. In addition, legal representatives were informed that participation was fully voluntary, and children could stop participating at any moment (though none of them did). Data were stored on the secure server of the Authors' University (details removed for blind review). Names of children were replaced by pseudonyms and were not used in publications or presentations.

Data analyses

The audio recordings were transcribed by the first author and two graduate students, resulting in a total of 36 transcripts. Transcripts were subsequently coded using self-constructed coding schemes.

Play activities. Based on discussions with a focus group of early childhood teachers, a coding scheme with five categories was developed to indicate children's play activities (see Table 3.1). This coding scheme was used to code the spoken observation reports. These reports were used as additional information (e.g., indicating to what kind of object or event children were referring to in their speech).

Table 3.1 *Observation Categories indicating Play Activities*

Observation Category	Example
1. Movement by (part/whole) body	Walks
2. Interaction with loose object(s)	Holds twig in right hand
3. Interaction with fixed object	Clasps hands on tree branch
4. Interaction with others (specify child or teacher)	Talks to play mate
5. Notice something with senses	Looks to the right
6. Other	Plays with zipper of coat

Language use. To measure children's language use, transcripts of the audio recordings were divided into speech utterances and coded in ATLAS.ti 9 (cf. Ninio, Snow, Pan & Rollins, 1994; also see Deunk, 2009). In the present study, an utterance was defined as an independent speech unit which is not interrupted by the turn of the conversation partner or by a pause. In assessing children's language use, we focused on two aspects: (1) the communicative intention and (2) the semantic content. The communicative intention indicates the communicative intention of the utterance (Tomasello 2003); the semantic content indicates the objects and events that are referred to and to which meaning is attributed during the evolving play activity. Differences in the communicative intention and the semantic content of children's language use between conditions (non-nature-based playground versus nature-based playground) were assessed using Wilcoxon Signed Rank Tests.

Language use: communicative intention. To code the communicative intention of children's utterances, a coding scheme was used that is based on the classification system of the Inventory of Communicative Acts-Abridged (INCA-A; Ninio et al., 1994). See Table 3.2 for an overview of the ten codes.

Table 3.2 *Codes for the Communicative Intention of Language Use*

Codes communicative intention	Description	Example
1. Call for attention	Speaker calls play mate/teacher	'Anna!'
2. Discussion	Exchange of information on various topics. A state of conversation is established/continued. Speaker talks about play activity, describes people, objects or places. Topic can be in present or past	'Oh, a lot really'
3. Language play	Words and/or sentences that are uttered as form of play	'Laptain, raptain, captain'
4. Laughing	Laughing: sounds or words	'Ha, ha, ha'
5. Marking	Acknowledge the occurrence of an event	'yes'
6. Metacommunication	Demands for clarification or confirmation of the meaning of hearer's past communications, or various statements about them	'Just kidding'
7. Negotiation	Directives for the hearer to bring about some future situation, commitments by which the speaker undertakes to bring about some situation. Also consists of a call for attention followed by a directive to perform a certain action	'You have to tag me too, Saree'
8. Performance	Performance of verbal moves in rule-bound activities. Performances of verbal moves count as meaningful only within the rule-bound activity	'tag' 'out'
9. Question	Question; various topics	'Does anybody need mud?'
10. XXX	Uninterpretable vocalizations or verbalizations of which the communicative intent is unclear	'Kendel kendel kendel'

Language use: semantic content. To code the semantic content of children's utterances, we used thematic content analysis with open coding (Boeije, 2010). This analysis consisted of four interrelated steps. First, we highlighted concepts that stood out in each utterance to arrive at a first set of codes (in vivo coding). Second, these initial codes were merged, and new codes were created (axial coding). For

example, 'acorns', 'sticks' and 'rocks' became 'interaction object natural', whereas 'shovels', 'bikes' and 'balls' became 'interaction object intentional'. Third, codes were then combined, and we identified patterns regarding the relation between the outdoor play environment and children's language use (selective coding). For example, 'explorative behaviour towards loose and fixed objects in the environment', 'counting objects', and 'comparing objects' were combined into the code 'inquiry'. Fourth, code document tables and code co-occurrence tables were created to compare the semantic content of children's language use between conditions (non-nature-based playground versus nature-based playground). Code document tables compare how many times certain codes are used in both conditions; co-occurrence tables show how often codes co-occur.

During the coding process, the first author and research assistant repeatedly discussed the identified codes and patterns in a cycle of coding sessions to prevent confirmation bias, obtain consensus on the utterances for which decisions had to be made, and eventually arrive at a state of saturation (Boeije, 2010). Furthermore, to improve the reliability of the coding process, the team performed a second coding round on the data of two children. Finally, codes were discussed with a team of early childhood experts. The coding process resulted in a coding scheme with eighteen codes (see Table 3.3). To measure the semantic content of children's language use, all transcripts were coded using this final coding scheme.

Table 3.3 *Codes for Semantic Content of Language Use*

Codes	Description	Example
1. Description person: competence	About things one can or cannot do (skills)	I've grown big too
2. Description person: non-competence	About feelings or emotions about oneself	'If I take a step, I get scared'
3. Displacement real	About events or objects that are not present here and now (not phantasy or pretend play)	'But, Liza, where are you going to celebrate?'
4. Inquiry: descriptive general	About the characteristics of an object/environment	'I feel something really hard'
5. Inquiry: explorative: environment	About exploration of the place, also directions, borders	'I think we are close here; I am going to look for it as well'
6. Inquiry: explorative: object	About exploration of objects, such as comparing objects, to look for, to find and to collect objects	'Amy, are we going to look for chestnuts?'

Table 3.3 *Continued.*

Codes	Description	Example
7. Inquiry: math, amount	Indicating amounts, counting, measuring length and height	'Did you know that graham is the biggest number in the whole world?'
8. Inquiry: sensory	Describing experiences with senses, smell, tactile. However, not 'look' to get someone's attention	'Look a little flower that is loose'
9. Inquiry: wonder, surprise	Expressing wonder or surprise	'Wow, a lot of cones'
10. Interaction: environment	About the interaction with surroundings, the place where they are	'I have to watch out for the nettles'
11. Interaction: object: intentional	About objects with a fixed function, brought in by teacher to play with	'I am going to yo-yo like this'
12. Interaction: object: natural	About interaction with objects and elements found in the play environment like stones, sticks, loose objects, also materials you can pick up with hands like mud and water	'Where do these rocks come from?'
13. Interaction: object: other	About interaction with object, other than natural and intentional, mostly brought from home, such as jacket, shoe, microphone	'These are my boots!'
14. Play: possession	About possession of objects or places	'It is mine!'
15. Play: role	About pretend play: roles you assign to yourself, playmates, objects, or environment	'Only people with a sharp stick may come in, and those who work here'
16. Play: rules and activities	About play activities and the rules of the play activities, also who can join or not	'Now you push, Tijn, no, I bike you'
17. Repeat	Repetition of an utterance	
18. YYY	Uninterpretable	'And the slides from'

Results

Language use: communicative intention

In Table 3.4, the mean numbers of utterances per code for the communicative intention of children's language use are reported, divided by condition (non-nature-based playground versus nature-based playground). In addition, mean proportions are provided to indicate the relative mean number of utterances per code (i.e., the mean number of utterances divided by the total number of utterances within condition). Finally, Table 3.4 shows the outcomes of Wilcoxon Signed Ranked Tests, indicating that there was a significant difference between conditions in 'language play' and 'negotiation'. Specifically, the relative mean number of utterances coded as 'language play' was significantly higher in the non-nature-based playground condition than in the nature-based playground condition. In contrast, compared to the non-nature-based playground condition, the relative mean number of utterances coded as 'negotiation' was significantly higher in the nature-based playground condition. Besides differences between conditions in the separate codes for communicative intention of children's language use, there was a significant difference in the total mean number of utterances between conditions. That is, the mean number of utterances was significantly higher in the nature-based playground condition than in the non-nature-based playground condition.

Table 3.4 *Mean Number and Mean Proportion of Utterances per Code for the Communicative Intention of Children's Language Use and Differences between Non-nature-based Playground and Nature-based Playground*

Codes communicative intention	Non-nature-based playground		Nature-based playground		Differences between playgrounds (Z)
	Mean (SD)	Mean proportion (SD)	Mean (SD)	Mean proportion (SD)	
1. Call for attention	1.50 (1.76)	0.04 (0.03)	2.22 (1.44)	0.04 (0.03)	-0.46
2. Discussion	11.56 (7.90)	0.31 (0.20)	19.33 (11.92)	0.33 (0.18)	-0.81
3. Language play	1.00 (1.24)	0.04 (0.07)	0.50 (0.71)	0.01 (0.02)	**-2.31***
4. Laughing	1.67 (1.94)	0.04 (0.04)	0.78 (0.94)	0.07 (0.02)	-1.79
5. Marking	5.61 (3.90)	0.13 (0.10)	5.89 (3.36)	0.20 (0.10)	-0.59
6. Meta-communication	0.72 (0.96)	0.02 (0.03)	0.39 (0.98)	0.06 (0.01)	-1.78
7. Negotiation	13.06 (10.33)	0.27 (0.16)	21.00 (13.95)	0.37 (0.18)	**-2.07***

Table 3.4 *Continued.*

Codes communicative intention	Non-nature-based playground		Nature-based playground		Differences between playgrounds (Z)
8. Performance	1.94 (3.39)	0.04 (0.07)	1.28 (2.16)	0.02 (0.04)	-0.56
9. Question	4.94 (4.24)	0.10 (0.08)	4.94 (4.24)	0.08 (0.06)	-0.72
10. XXX	1.11 (1.78)	0.03 (0.05)	1.00 (1.46)	0.02 (0.03)	-0.65
Totals	43.17 (19.30)	1.00 (0.00)	57.33 (19.6)	1.00 (0.00)	**-2.68****

Note. Wilcoxon Signed Ranked Tests were performed with mean proportions (except for totals) and all p values in this table are two-tailed; *p ≤ .05. **p ≤ .01. ***p ≤ .001.

Language use: semantic content

In Table 5, the mean numbers of utterances per code for the semantic content of children's language use are reported, divided by condition (non-nature-based playground versus nature-based playground). In addition, mean proportions are provided to indicate the relative mean number of utterances per code (i.e., the mean number of utterances divided by total number of utterances within condition). Finally, Table 3.5 shows the outcomes of Wilcoxon Signed Ranked Tests, indicating that there was a significant difference between conditions in 'inquiry: explorative object', 'inquiry: math, amount', 'interaction: object: intentional', and 'interaction: object: natural'. Specifically, the relative mean number of utterances coded as 'interaction: object: intentional' was significantly higher in the non-nature-based playground condition than in the nature-based playground condition. In contrast, compared to the non-nature-based playground condition, the relative mean number of utterances coded as 'inquiry: explorative object', inquiry: math, amount', and 'interaction: object: natural' was significantly higher in the nature-based playground condition. Besides differences between conditions in the codes for semantic content, there was a significant difference in the total mean number of utterances between conditions. That is, the mean number of utterances was significantly higher in the nature-based playground condition than in the non-nature-based playground condition.

Table 3.5 *Mean Number and Mean Proportion of Utterances per Code of Pragmatic Aspect and Differences between Non-nature-based Playground and Nature-based Playground*

Codes semantic content	Non-nature-based playground		Nature-based playground		Differences between playgrounds (Z)
	Mean (SD)	Mean proportion (SD)	Mean (SD)	Mean proportion (SD)	
1. Description person: competence	0.50 (0.93)	0.01 (0.03)	0.89 (1.81)	0.01 (0.03)	0.00
2. Description person: non-competence	0.89 (1.53)	0.02 (0.04)	1.72 (1.99)	0.03 (0.04)	-1.08
3. Displacement real	0.78 (1.59)	0.02 (0.04)	1.22 (2.32)	0.02 (0.03)	-2.60
4. Inquiry: descriptive general	1.33 (1.72)	0.05 (0.06)	1.22 (1.31)	0.02 (0.02)	-1.92
5. Inquiry: explorative: environment	0.06 (0.24)	0.00 (0.00)	1.06 (2.24)	0.01 (0.03)	-1.75
6. Inquiry: explorative: object	0.06 (0.24)	0.00 (0.00)	2.94 (4.12)	0.03 (0.04)	**-2.52***
7. Inquiry: math, amount	0.28 (0.58)	0.01 (0.01)	2.72 (3.64)	0.03 (0.04)	**-2.67****
8. Inquiry: sensory	0.28 (0.75)	0.01 (0.04)	1.00 (2.64)	0.01 (0.03)	-0.41
9. Inquiry: wonder, surprise	0.61 (1.29)	0.01 (0.02)	0.94 (1.47)	0.01 (0.02)	-0.45
10. Interaction: environment	1.00 (1.78)	0.04 (0.08)	7.11 (5.90)	0.10 (0.08)	-1.86
11. Interaction: object: intentional	4.50 (5.53)	0.11 (0.13)	0.67 (2.11)	0.01 (0.02)	**-3.18****
12. Interaction: object: natural	1.72 (3.83)	0.07 (0.15)	13.06 (10.13)	0.18 (0.12)	**-2.68****
13. Interaction: object: other	2.06 (6.07)	0.04 (0.10)	1.17 (1.95)	0.02 (0.04)	-0.38
14. Play: possession	0.33 (0.97)	0.01 (0.02)	1.39 (2.23)	0.01 (0.02)	-1.41
15. Play: role	2.83 (5.91)	0.06 (0.11)	6.94 (9.84)	0.08 (0.10)	-0.63
16. Play: rules and activities	18.94 (13.02)	0.47 (0.23)	22.94 (9.96)	0.36 (0.14)	-1.37
17. Repeat	3.33 (3.88)	0.07 (0.23_	3.39 (2.87)	0.05 (0.03)	-1.07
18. YYY	0.17 (0.51)	0.00 (0.01)	0.44 (0.86)	0.01 (0.01)	-0.31
Totals	39.67 (23.28)	1.00 (0.00)	70.83 (32.09)	1.00 (0.00)	**-3.20****

Note. Wilcoxon Signed Ranked Tests were performed with mean proportions and all p values in this table are two-tailed; *p ≤ .05. **p ≤ .01. ***p ≤ .001.

Besides assessing the differences between conditions in the relative mean number of utterances per code for the semantic content of children's language use, our thematic content analysis of the semantic content resulted in four major themes.

Theme 1: Language use during outdoor play is embedded in the social play situation.

In both the non-nature-based playground and the nature-based playground, many utterances were coded as 'play: rules and activities' and 'play: role' (see Table 5). This indicates that the interactions of young children during outdoor play are largely focused on making sense of play activities, independent of the specific condition (non-nature-based versus nature-based playground). In other words, children used their language in the first place to direct their interactions with their playmates.

Theme 2: Language use during outdoor play is embedded in the physical environment.

Code co-occurrence analysis showed that in the nature-based playground, the codes 'play: possession', 'play: rules and activities', and 'play: role' (the codes that uncovered our first theme) co-occurred often with the codes 'interaction: environment', 'interaction: object: intentional', 'interaction: object: natural', and 'interaction: object: other'. For example, 'Only people with a sharp stick may come in, and those who work here'. These types of utterances not only referred to the play activity (playing people who work) and the rules (playing people with rules for coming in), but also to the interaction with loose and fixed elements of the environment (the sharp sticks and the nook that functioned as the workplace) and the meaning (role) they were assigning to themselves and the objects of the environment as well. In addition, outcomes of Wilcoxon Signed Ranked Tests indicated that in the non-nature-based playground condition there were more utterances on objects with an intentional meaning (climbing construction, bikes, balls, shovels) than in the nature-based playground condition, whereas in the nature-based playground condition there were more utterances on natural objects (flowers, twigs, mud) than in the non-nature-based playground condition. Although in both conditions children talked about the objects they were playing with, in the nature-based playground condition children used twice as many utterances referring to these objects. In addition, utterances on the use of the environment as a place ('interaction environment') occurred twice as much on the nature-based playground than on the non-nature-based playground. This shows that the language use in the nature-based playground was not only embedded in the play situation, but in the use of the physical environment as well.

In other words: Compared to the non-nature-based playground, children played in the nature-based playground condition more *with* and *in* the environment and their language use was scaffolded or guided by the natural environment.

Theme 3: Nature as a play partner, a rich conversational setting for inquiry and role assignment.

Code co-occurrence analysis indicated that the code 'interaction: environment' co-occurred 125 times with the six codes of inquiry ('descriptive general', 'explorative: environment', 'explorative: object', 'math, amount', 'sensory wonder', 'surprise') within the nature-based playground condition. Within the non-nature-based playground condition, these codes co-occurred only 22 times. In addition, outcomes of Wilcoxon Signed Ranked Tests indicated that in the nature-based playground condition there were significant more utterances on inquiry of (natural) objects. This might indicate a relation between talking about the functionality of the environment (and its objects) and talking about inquiring the possibilities and the meaning of the environment (and objects) for play activities. Before using a natural object as a tool, children inquired the characteristics of the object, for example by talking about the length or the sturdiness of a stick or the origin of a pinecone (Table 6). In the non-nature-based playground, on the other hand, a shovel was just a shovel without any utterance on its characteristics. Furthermore, the 396 utterances on 'interaction with objects or environment' during play in a nature-based playground co-occurred 70 times with the concept 'role', whereas this co-occurrence was only found eight times during play in a non-nature-based playground. This indicates a possible relation between talking about the functionality of the environment and its objects for play and assigning a role to the natural environment to play with it. The examples in Table 3.6 illustrate Theme 3.

Table 3.6 *Examples of Relation between Inquiry of Objects and Role Assignment in the Nature-based Playground Condition*

Inquiry: Dexx (aged 5;0) is looking for pinecones in the park		Object and role assignment: Anna (aged 5;7) is building a pretend bonfire out of twigs, private speech	
Dexx	'Look what I found'	Anna	'Do you have some good twigs?'
Other	'Wow, a lot of cones'	Anna	'Oo, this is a good sturdy twig'
Dexx	'Look, one, two, three, four'	Anna	'I have to be careful of the nettles'
	'Where can I sow them?'	Anna	'Nice bonfire'
	'They come out of the ground'	Anna	'Here, I have another new twig'

Table 3.6 *Continued.*

Inquiry: Dexx (aged 5;0) is looking for pinecones in the park		Object and role assignment: Anna (aged 5;7) is building a pretend bonfire out of twigs, private speech	
Other (teacher)	'Really?'	Anna	'The bonfire is getting quite sturdy with a twig, a twig, a twig, a twig'
Dexx	'They all come, they come they they they'		
Other (teacher)	'Go and look carefully at that tree'		
Dexx	'No, you are kidding'		

Note. Grammatical errors are intentional

Theme 4: Physical characteristics of natural environments challenge scientific reasoning.

Outcomes of Wilcoxon Signed Ranked Tests indicated that there were significant more utterances on 'inquiry: math amount' in the nature-based playground condition than in the non-nature-based playground condition. Code co-occurrence analysis showed that this code often co-occurred with the code 'interaction object natural' or 'interaction environment'. This might indicate that playing in the nature-based playground challenged children to manipulate, explore, and measure the objects in the nature-based playground more often than in the non-nature-based playground. Table 3.7 illustrates the fourth theme. The logs the children were playing with, were uneven in height, so standing on top of them changed the original height difference between them, which created a conversational setting for reasoning about uncountable numbers. The elements of the natural environment encouraged children to use language or concepts related to mathematics and science.

Table 3.7 *Example of the Relation between Mathematical Reasoning and Play in Natural Environment*

Setting 'Math': Jelle (aged 5;11) is talking to a playmate, while balancing on logs, measuring each other's heights	
Jelle	'Did you know that graham is the biggest number in the whole world?
Other	'What is the biggest number?'
Jelle	'Graham'
Other	'What kind of number is that?'
Jelle	'It is an uncountable number, yes it really is uncountable'
Other	'Look there is another step' (a log where they could step upon)

Table 3.7 *Continued.*

Setting 'Math': Jelle (aged 5;11) is talking to a playmate, while balancing on logs, measuring each other's heights	
Jelle	'I am graham'
Other	'I am graham, cause I am now taller than you'
Jelle	'Yes, but I am graham as well, we both are graham, only you are a little taller'

Discussion

The current study was designed to explore how the physical environment is related to children's language use during outdoor play. Using audio recordings and observations of children's play activities, we compared their language use during play in two different play environments: The non-nature-based playground of the school and a nature-based playground (i.e., a park or school garden close to the school). Results of Wilcoxon Signed Ranked Tests and thematic analysis of transcribed utterances of children's language use confirmed our hypothesis that there is a relation between the physical outdoor environment and both the quality and the quantity of children's language use. Specifically, we found that in the nature-based playground the children were more talkative, they negotiated more often in order to communicate the meaning they attributed to the objects and this made the utterances semantically more layered and complex, which is in line with previous studies (Cameron-Faulkner et al., 2017, 2018; Richardson & Murray, 2016). We will discuss four themes that are helpful in uncovering different aspects of the relation between the physical environment and children's language use in the following sections.

Language use during play is embedded in the direct play situation

Our data shows that the context of outdoor play in both the non-nature-based playground and the nature-based playground supports children's language use. In other words, the context of outdoor play in a nature-based or non-nature-based playground as a practice is not only beneficial for children's physical health but might also support their language development. The conversational setting of both conditions provided children with opportunities for using complex language (Deunk, 2009; Hoff, 2006): In both playgrounds, most of the utterances were related to the rules of the play or the performance of the play activity. As shown by other studies, the conversational setting that characterizes outdoor play, such as freedom in choice of activities and playmates as well as less interaction with adults, influences the quality of the language (Deunk, 2009; Pellegrini & Bohn, 2005). The conversa-

tional setting during outdoor play provides children with many opportunities for language use in both environments. However, the findings of our study indicate that the richness of the conversational setting of outdoor play was amplified in the nature-based playground.

Language use embedded in the physical environment

Our study indicates that the characteristics of nature-based playgrounds offered added value to children's meaning making processes, evoking more utterances and more semantic complexity. These processes appeared to be not only dependent on the beneficial social-cultural context any outdoor play situation has, but also on the specific context of the nature-based playground and its objects. In other words, our findings highlight a relation between the physical environment on the one hand and the number of utterances and the complexity of these utterances on the other hand.

One possible explanation for the added value of the nature-based playground is its restorative effect on children's attention (Faber Taylor & Kuo, 2009; Kaplan, 1995; A. F. Taylor et al., 1998). According to Tomasello (2003), joint attention makes it possible to read the intention of the person you communicate with. Tomasello (2003) describes joint attention and intention reading as two foundational factors for language use that make it possible for children to use linguistic symbols in communication. This might explain the higher amount and complexity of children's utterances during play in a natural environment (Cameron-Faulkner et al., 2018), but it does not account for the higher amount of utterances that were used to guide the interactions with the loose and fixed objects of the nature based playground.

So, how can the high frequency of children's language use about the use of (objects in) the nature-based playground be explained? Considering that the type of play afforded by a physical environment is dependent on a reciprocal relation between the environment and the child playing in it, (Gibson, 2014; Heft, 1988), one possible explanation might be the functionality of both physical environments for play and language use (Heft, 1988).

The functionality of a physical environments emerges from how children experience the environment and how they relate to its features. A given feature, such as a tree trunk affords multiple affordances. In our study, the functionality of the non-nature-based playground differs from the functionality of the nature-based playground. For example, the climbing structure that was part of the non-nature-based playground affords climbing for the children who can climb and like to do it, but the non-climbers do not use it. The functionality of the nature-based playground is more flexible and adaptable. For example, a tree affords climbing for the climbers,

but at the same time it affords a hiding place for the children playing hide and seek, or a leaning to for participants of a pretend tea party. To use all these affordances, children must discuss and negotiate, which might explain the relation between the functionality of the playground and the number of utterances.

As shown by other researchers, natural environments afford more diverse play activities than non-natural environments (Fjørtoft, 2004; Heft, 1988; Lisa P. Kuh et al., 2013; Luchs & Fikus, 2013). In our study, the utterances on the nature-based playground concerning the use of objects (loose and fixed) as some sort of tool exceeded the number of utterances that were used in this way on the non-nature-based playground. This might indicate that the opportunity for tool use might also be a key factor in explaining the differences between children's language use in the two conditions.

Finally, our findings show that the diversity in the affordances of the nature-based playground including tool use, also seem to guide, scaffold, and evoke more (complex) language use. To further explore this finding, we need to take a closer look at the third theme that emerged from the semantic content analysis.

Nature as a play partner, exploration and role assignment

Object play on the nature-based playground was accompanied by many utterances to attribute meaning to the objects in the process of the evolving play activity, according to their materiality and properties. This stimulated children to frequently use semantic layering in their language. For example, during play in the nature-based playground, the sturdiness of the stick is discussed in relation to its use as part of a pretend bonfire in one utterance. Language was used to transform the physical environment from 'strange' to 'familiar', from twig to bonfire. In some utterances, children appeared to perceive the 'living' character of the nature-based playground, possessing a mind of its own. For example, during one of the play activities in our study two children were discussing what to do with the plant when it was growing through the roof of their pretend house in the shrubs. Strong-Wilson & Ellis (2009) described how in the Reggio Emilia approach, the physical environment can take on a life of its own and children relate to this. Earlier research on children's place attachment showed that nature, as the physical environment for play, serves as a source for sensory play, as flexible material for pretend play, and as an environment for autonomy and adventure (Chawla, 2015; Ellis, 2004; R. Hart, 1979). In our data, the materiality of the natural loose parts such as sticks, stones, mud and acorns play an important role in children's language use. On the contrary, the materiality of the objects in the non-nature-based playground was often taken for granted:

Children did not talk about what a plastic shovel is made of. This demonstrates another factor in the explanation of the differences in language use between both play environments. The sensory richness and the diversity of the nature-based playground enhanced the semantic complexity of children's language use, since it afforded the need to explore these objects to get acquainted with them and to use them in their play activities.

Science and math

Our final theme emerged from all the utterances that were used to count or measure the objects on the nature-based playground, and utterances that had to do with exploring natural phenomena such as gravity or the circle of life. These utterances were only found when children were playing in the nature-based playground. Our data demonstrated that on the nature-based playground children used language to predict and check the numbers or measures of the objects they used, such as sticks and pinecones. Besides, children asked questions about the circle of life of a pinecone and the use of the slope of a very small hill to roll logs downward, exploring how gravity influenced the speed. Science is a method of asking questions about the environment and mathematics is to be seen as a human activity of schematizing and dealing with quantitative and spatial relationships (Freudentahl, 1978). It should be recognized that language and knowledge about scientific concepts are two sides of the same coin which explains why the nature-based playground might be suitable place for scientific reasoning (Gelman, 2006; Hoff, 2006)

For all four themes it could be argued that they emerged not only because of the different nature of the two environments, but also because of the differences in practices that regulate which affordances can be utilized or shaped, and when, where, and how this is done. One could argue that the cultural norms around using the affordances of the non-nature-based playground were more restrictive. For example, children are not allowed to take the concrete tiles out of the playground floor, whereas they are free in taking twigs from the floor in the park. Another element in this practice is how often the children play in both environments. Although the non-nature-based playground of the schools was used more frequently than the nature-based playground, all children were used to playing in the nature-based playground as well. However, as we cannot separate the socio-cultural environment from its physical element, we also cannot separate the physical environment from its sociocultural norms. Considering this, the striking difference between the relationship between the play environment and children's language use remains.

Strengths, limitations and future research

Our study explored an exciting new aspect of the benefits of nature for children's development: The relation between natural environments and language use. The children participating in the study came from different socio-cultural backgrounds and attended three different schools which was a strength of the study. We included monolingual children as well as bilingual children. Although the three schools had different playgrounds and the natural environments they used to play in, were different, the findings were consistent. Given the exploratory nature of the current study, future research should focus on the longitudinal effects of nature play on language development involving a larger sample. We might expect lasting effects of playing in a natural environment on children's language development, since language acquisition is usage-based (Tomasello, 2003). Due to the start of the COVID-pandemic while conducting our research, the number of participants in our study was limited which was a limitation of the study, this was mitigated by using a within-subjects design. Finally, it would be interesting to do the same study with children at an earlier stage of language development.

Conclusion

This explorative study showed that nature-based playgrounds are a richer conversational setting for using language, than non-nature-based playgrounds. They have the potential to scaffold and guide rich language use; meaning making processes on a nature-based playground contribute to more language use and to language use with more semantic layers. A characteristic of the adult language system is that it is not dependent on the immediate context: the socio-cultural environment including its physical dimension. For children, the meaning making processes during play are more dependent on the (socio-cultural) environment. Our study showed how the physical dimension is an important factor of this context, even when children transform it into a fictive environment with their use of language (Halliday, 1975). The findings of the current study might encourage early childhood educators to enrich their outdoor play practices, by incorporating playing in a natural environment in their practice or by greening their school playground. Furthermore, to make use of the possibilities of outdoor play in a nature-based environment as a rich conversational setting for language use, specifically in schools within highly urbanized environments.

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4

Nature play in early childhood leads to great and varied language production

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Submitted to Scientific Reports

Abstract

Active play opportunities in nature are beneficial for healthy child development: Recent reviews have shown that playing in natural environments contributes to children's motor skill improvement, attention restoration, play skill diversification, and has an impact on wellbeing and cognitive development. This study focuses on the benefits of nature play for productive vocabulary, which is important for learning to read in later years. We investigated the effect of playing in a nature-based environment on preschooler's (2-4 years old) word production using language sample analysis. A total of N = 30 children (2–4 years) from three Dutch early childhood centres participated. To measure children's productive vocabulary, we recorded their language production for ten minutes while playing in two conditions: 1) a non-nature-based playground and 2) a nature-based playground. Audio tapes were transcribed, and the total number of words and the number of unique words were counted. Findings indicated a positive effect of playing in the nature-based playground on both the total number of words spoken by the children and the number of unique words. These results suggest that nature-based play environments may support the growth of children's productive vocabulary.

Introduction

Recently, research on playing within nature (i.e., forest, green spaces, parks, gardens) has shown that active play opportunities in nature and outdoors are strongly advantageous for healthy child development (Tremblay et al., 2015). Unfortunately, most children now live in highly urbanized cities (United Nations Department of Economic and Social Affairs Population Division, 2022) where the access to urban green spaces is declining (Colding et al., 2020).There has been a global concern about the time young children spend outdoors, due to urbanization, increased screen time and parental safety concerns (Ng et al., 2014). The age young children start to engage with screens has fallen from the age of four in 1970 to four months nowadays (A. D. Wilson et al., 2013). Furthermore, children are more and more limited in their opportunities to freely play in their local vicinities (Tremblay et al., 2015). This has changed the life of young children tremendously. Is this problematic? This might be the case. Given the importance of nature play for young children's development, a decline in playing outdoors might hinder their development. For example, recent reviews have shown that playing in nature contributes to children's motor skill improvement, attention restoration, play skill diversification, and also has an impact on wellbeing and cognitive development (Dankiw et al., 2020; Johnstone et al., 2022; Prins et al., 2023). These reviews also show that fewer studies looked at the benefits of nature play for cognitive development. In particular, only a few studies focused on effects of playing in nature-based places for young children's language development (Cameron-Faulkner et al., 2018; Prins et al., 2023; Richardson & Murray, 2016). Therefore, in the current study we focus the benefits of nature play on children's language development. Specifically, we will focus on their productive vocabulary, as this is particularly important in early childhood. It supports higher-order thinking and better vocabulary skills, which are the foundation of learning to read in later years (Green, 2021).

The focus of our study also aligns with Cameron-Faulkner's et al. (2018) suggestion that future research should evaluate the potential of nature-based places as context for language interventions in early years settings. In our own previous explorative study (Prins et al., 2023), we found that language use during play in nature-based places reflects the richness of the place. Specifically, we found that nature-based places supported the use of rich concepts and that it was related to the complexity of communicative intentions in 4- to 7-year-old children. Furthermore, we found a difference in the quantity of the utterances used when playing in nature-based places compared to non-nature-based paved playgrounds. These

findings hold significant implications, particularly for young children aged 2-4 years, as the quantity of language production correlates with their language development (Bornstein & Haynes, 1998; von Stumm et al., 2020). For example, one of the most powerful predictors of a child's success in school is vocabulary size at kindergarten entry (Snow et al., 1998). Therefore, in this study we aim to assess the impact of playing in nature-based places on the quantity and diversity of word use of preschoolers aged 2-4 years.

Literature review

Developmental benefits of playing in nature-based environments

In the current study, we define nature-based environments by the following characteristics: Nature-based environments (1) have a biodiverse surface on which living creatures like plants, shrubs and fungi grow, (2) they provide possibilities for interaction with living creatures like plants, trees, insects, (3) they provide loose materials to play with, such as sticks, seeds, feathers and shells (attached and detached 'objects'), (4) they contain non-living element such as water, rocks and soil (substances), and (5) are dynamic, as weather elements such as fresh air, rain, wind and sunshine, or seasonal elements such as blooming or decay constantly change the environment (Prins, van der Wilt, et al., 2022). These characteristics of nature-based environments are known to support play quality of preschoolers in several ways. Firstly, in line with affordances theory, nature-based places may afford more play possibilities for a child or a group of children than other environments (Gibson, 2014). The nature-based place affords what is in line with a child's developmental stage and is adaptive to it. For instance, the stage of their motor development determines if a tree affords leaning (for a 1-year old), hiding (for a 5-year old), or climbing (for a 7-year old)(Heft, 1988). Secondly, play behaviour in nature-based places tends to be more diverse compared to man-made environments (Dankiw Id et al., 2020; Prins, van der Wilt, et al., 2022). Diversification of play is an element of play quality since it leads to practicing social skills, problem solving, creativity, taking risks and self-regulation (Johnstone et al., 2022). The third way play quality is supported by nature, is that nature-based places support children to develop a sense of place as part of their identity (Boyd, 2019), where they experience the environment as something that plays back (Harwood & Collier, 2017; Prins et al., 2023). This points to the pedagogical function of nature-based places.

Language learning in nature-based environments

Given that nature-based environments support play quality, it is plausible that nature-based places support children's language production during play. There has been substantial research into the importance of the environment for language development. Most of these studies focused on the conversational or verbal environment. For example, multiple studies show that verbal interactions both at home and at school are the primary sources from which children learn to interpret communicative intentions and understand new words (Marulis & Neuman, 2010; Tomasello, 2012). Besides, many studies have shown that several conversational contexts, such as mealtime conversation, daily routines or play activities are supportive contexts for word learning (Masek, L. R., Scott, M. E., Dore, R., Luo, R., Hirsh-Pasek, K., & Golinkoff, 2018; Neuman & Roskos, 1992). Unfortunately, the aforementioned studies do not take the physical characteristics of the environment in which words are learned into account. When studies did investigate features of the physical environment in language learning, these features were books or early literacy stimulating props, such as pens and paper (K. A. Roskos et al., 2010). It remains unanswered if and through which mechanisms nature-based environment affect children's language learning. Environments that support language learning should capture children's attention, challenge their thinking (K. Roskos & Christie, 2011), and/or stimulate their understanding of rich concepts (Snow, 2017). A few studies into the relation between the nature-based environment and language learning have suggested that natural environments may indeed influence language use. Cameron-Faulkner et al. (2018), for example, showed how the living nature of a botanical garden impacted the social interactions between parents and children. Specifically, their study showed that an increase in the length of connected communication episodes and the levels of responsiveness relative to communication in the indoor education centre of the botanical garden environment. Richardson and Murray (2016) and Prins et al. (2023) showed how that the quality of kindergartners (4-7 yrs.) utterances is supported in nature-based environments. They did so by comparing the communicative functions of their utterances in two conditions: a non-nature-based playground and a nature-based yard. Although these studies offer some evidence on how nature-based environments might support children's language use, no studies have experimentally investigated the effect of playing in nature-based places on the quantity and quality of word use in preschoolers.

Rationale for this study and research questions:

In this study, we investigated the relation of playing in a nature-based environment and preschooler's (2-4 years old) word production using language sample analysis. Language sample analysis is a direct, objective and reliable practice for the assessment of children's expressive language (Greenwood, 1998; Wilder & Redmond, 2022; Yang et al., 2022). The total number of words in a sample measures verbal productivity and the total number of unique words measures the lexical diversity (Wilder & Redmond, 2022). Specifically, we used short conversational language samples of 10 minutes to compare the total number of words (tw) and total number of unique words (tuw) uttered by preschoolers in two different places: the non-nature-based part of the schoolyard (e.g., paved) and the nature-based part of the school yard (e.g., green). We used a within subject design.

We aimed to answer the following research questions:

1. What are the differences between young children's language use in a nature-based outdoor play environment and a non-nature-based play environment? (RQ1)
    a. What is the difference in the total number of words (tw; word count)? (RQ1a)
    b. What is the difference in the number of unique words (tuw; word diversity)? (RQ1b)

Based on the state of the art we expected that the diversity and dynamics of the characteristics of the nature-based outdoor play environment compared to the non-nature-based environment would be reflected in children's word use in a higher word count and higher word diversity in the nature-based environment.

Materials and methods

Context

This study was conducted at two Dutch early childhood education (ECE) centres, which were located in highly urbanized areas. We worked with 3 preschooler groups (n=2 groups in location 1; n=1 group in location 2), consisting of children between two and four years old. In general, children in both locations played outside for at least one hour a day. The non-nature-based playgrounds of the two participating centres were paved and had a climbing structure and a sandpit. Both ECE centres also had a small nature-based part in their yard, with plants and shrubs or trees, a small grassy lawn, and loose natural objects such as sticks, and stones (nature-based playground) see photos 1-4.

Foto 1
Nature-based place location 1

Foto 2
Nature-based place location 2

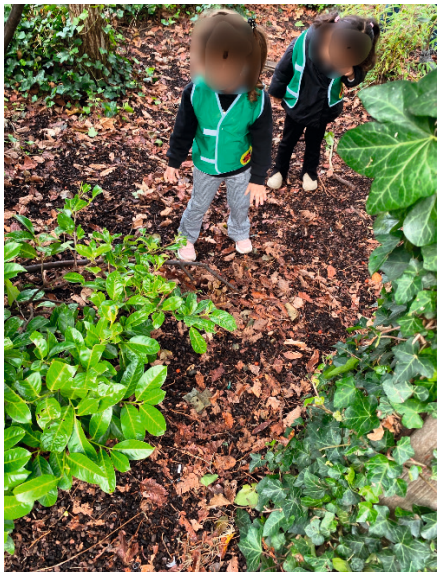

Foto 3
Non-nature-based place location 1

Foto 4
Non-nature-based place location 2

Participants

A total of *N* = 31 children (sixteen boys, fifteen girls) aged from 2;4 year to 3;11 year (*M* = 3;3, SD = 0;4) from two ECE centres participated in this study. Outcomes of the Dutch language screening instrument (Luinge et al., 2007) indicated that all but one of the children had a normal language development according to their achievement of important developmental milestones. For one child, the test indicated that there were concerns and that further testing by a speech therapist was needed. In consultation with the early childhood educator, this child's data were excluded from the analyses. For 25 children (83%), Dutch was their first language; for the remaining five it was either Turkish (3; 10%) or Portuguese (2; 7%).

We obtained informed consent from the legal representatives of the participating children. In addition, legal representatives were informed that participation was fully voluntary, and children could stop participating at any moment (though none of them did). In location 1 we obtained consent for 27 children from two separate groups and in location two we obtained consent for nine children. However, on the day of the experiment three children were absent in location one, two children were absent in location two, and one child was excluded from the dataset (see before). This resulted in a total of 30 children participating in the current study. Names of children were replaced by pseudonyms and were not used in publications or presentations. The present study was part of a larger research project for which ethical approval was obtained from the ethics review committee DPECS, Department of Psychology, Education and Child Studies Erasmus University Rotterdam (#19-032.R1).

Measures

Language production

Children's language production was measured by recording children's speech with a portable audio recorder for 10 minutes in two different outdoor play conditions. We recorded all children's speech during play in condition one, which was a nature-based part of the school yard, containing natural elements and objects (e.g., vegetation, shrubs, and loose elements such as sticks and rocks) and in condition two which was a non-nature-based playground (the schools' paved playgrounds, containing a climbing structure and a sandpit). The two conditions were counterbalanced. The participating groups (group A and B in location one and group C in location two) were divided into seven smaller groups (a-g), each consisting of three to five children. Four groups (a, c, e, f) started in condition 1, and three groups (b, d, g) started in condition 2 (see Table 4.1). The teachers were asked not to interact with the children during the 10 minutes

play time in both conditions. The children wore safety vests ('play jackets') with a pocket containing a portable voice recorder. All children wore the vests over their coats during outdoor play. In total, 62 ten-minute audio recordings were collected.

Table 4.1 *Counterbalancing conditions*

	Location 1 group A	Location 1 group B	Location 2 group C
1. nature-based 2. non-nature-based	a c	e	f
2. non-nature-based 1. nature-based	b	d	g

Play activities

Children's play activities were observed using video-observations. Outdoor play activities of participating children in both conditions (e.g., non-nature-based and nature-based) were video-recorded by trained research assistants. Video-recordings were used to understand the audio recordings. Young children commonly mispronounce words; therefore, watching the play actions on video tape made it easier to understand the words, for instance if a child was picking up an object or used a stick as a lawn mower.

Procedure

Schools were recruited through the professional network of the first author. Early childhood teachers were informed about the goal and procedures of the current study and were asked to play outside with their children in two different play environments. A week before data collection the first author of this paper visited the ECE centres to inform the children and handed them the 'play jackets' without the voice-recorders for the children to get used to wearing them. During data collection, the first author of this paper informed the teachers and children on the procedures and handed out the 'play jackets' with the portable voice recorders. Children with no consent to participate in the study were handed a 'play jacket' with an imitation voice recorder. The start and end of the 10-minute period was marked by ringing a bell. After the outdoor play activity, all 'play jackets' were retrieved and children and their teacher were thanked for their participation.

Data analyses

Audio recordings were transcribed verbatim by the first author and an early childhood expert, resulting in a total of 60 transcripts. Video recordings of the play activities were used as additional information (e.g., to what kind of object or event children

were referring to in their speech), mostly to check transcripts in the context of the play activities. Three children with Turkish as their first language, spoke Turkish during outdoor play time. These six audio recordings were transcribed by a bilingual primary school teacher and subsequently translated. Two children with Portuguese as their first language spoke Portuguese during outdoor play time. These four audio recordings were transcribed by a bilingual teacher from a teacher college and subsequently translated.

Next, the total number of words (tw) and the total number of unique words (tuw) were calculated for each transcript. A repeated-measures ANOVA was performed to assess the difference in the total number of words (tw; RQ1a) and the number of unique words (tuw, RQ1b) between conditions (non-nature-based environment vs nature-based environment).

Results

Our first analysis focused on the total number of words in each condition. A repeated-measures ANOVA was performed to assess the effects of the type of play environment (nature-based vs. non-nature-based) on the total number of words (tw) produced by children. The results are presented in Table 4.2. The ANOVA showed a significant main effect of RM Factor 1 (F (1, 25) = 5.185, p = 0.032, η^2p = 0.172), indicating that the nature of the environment (nature-based vs. non-nature-based) influenced the total number of words spoken. The number of words spoken in the nature-based environment was significantly higher than the number of words spoken in the non-nature-based environment. Interactions between RM Factor 1 and other factors (location, play condition order, and age) were not significant (all p > 0.05)

Table 4.2 *Results of a repeated measures ANOVA on the total number of words (tw)*

Source	Sum of Squares	df	Mean Square	F	p	η^2p
RM Factor 1 (nature-based vs non-nature-based)	15675.231	1	15675.231	5.185	0.032	0.172
RM Factor 1 ∗ Location	150.402	1	150.402	0.050	0.825	0.002
RM Factor 1 ∗ Order	1106.560	1	1106.560	0.366	0.551	0.014
RM Factor 1 ∗ Age	11531.739	1	11531.739	3.814	0.062	0.132
RM Factor 1 ∗ Location ∗ Order	3796.868	1	3796.868	1.256	0.273	0.048
Residuals	75585.172	25	3023.407			

Our second analysis focused on the total number of unique words (tuw) in each condition (see Table 3). A repeated measures ANOVA was conducted to assess the effects of various factors on the total number of different words (tdw) produced by children. The results are presented in Table 4.3 Results of the ANOVA indicated a significant main effect of RM Factor 1 (F (1, 25) = 16.116, p < .001, η^2p = 0.392), indicating that the nature of the environment (nature-based vs. non-nature-based) influenced the total number of unique words (tuw) spoken. Interactions between RM Factor 1 and other factors (location, play condition order and age) were not significant (all p > 0.05). Figure 4.1 shows the comparison between the words spoken in the two conditions

Table 4.3 *Results of a repeated measures ANOVA on the total number of unique words (tdw)*

Source	Sum of Squares	df	Mean Square	F	p	η^2p
RM Factor 1 (nature-based vs non-nature-based)	6057.183	1	6057.183	16.116	< .001	0.392
RM Factor 1 ∗ Location	1198.836	1	1198.836	3.190	0.086	0.113
RM Factor 1 ∗ Order	760.727	1	760.727	2.024	0.167	0.075
RM Factor 1 ∗ Age	427.670	1	427.670	1.138	0.296	0.044
RM Factor 1 ∗ Location ∗ Order	1329.449	1	1329.449	3.537	0.072	0.124
Residuals	9396.464	25	375.859			

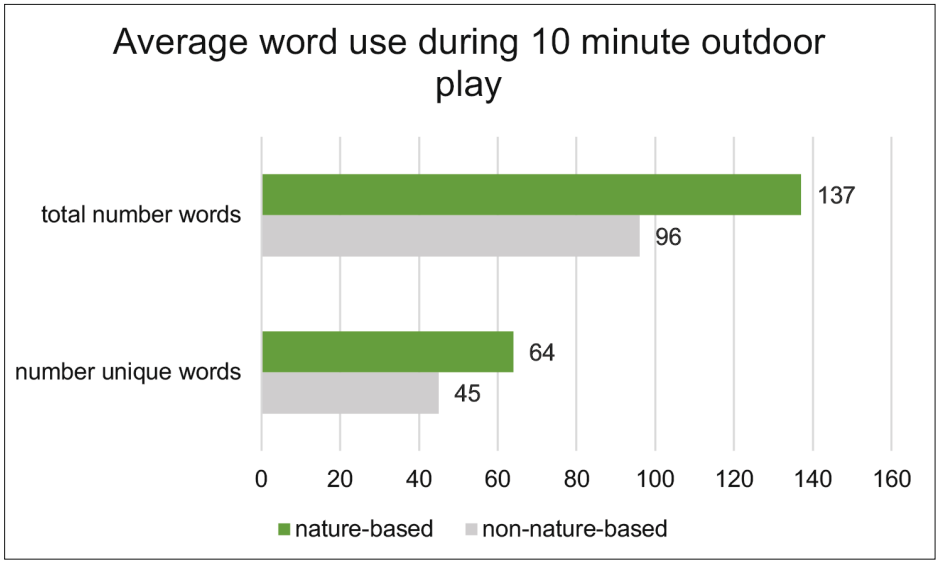

Figure 4.1 *Comparison between the total number of words (tw) and total number of unique words (tuw) for both conditions*

Table 4.4 shows a comparison between the conversations of two children, Lucas and Daan, both three years old. The conversations show how the words used in the nature-based place refer to the actual, physical place where Lucas and Daan are, whereas the words used in the non-nature-based place refer to either imaginative gnomes (Lucas) or to the game that is played (Daan), but in both cases the place itself is not referred to.

Table 4.4 *Conversations in nature-based and non-nature-based places*

Lucas (3 yrs.) (L), plays with friend Billy *(B)* in the vegetable garden (Minute 3-6)	**Lucas (3 yrs.), plays with *three friends(F)* on the schoolyard (Minute 2-6)**
L: Vegetable garden. *B: What's this Lucas?* L: Oh, that called just a thistle. A thistle so do not touch it. *B: It is not sharp, you know,* *I am gonna use a rake.* L: I am gonna use a rake too. I look like a lawn mower. You know how this looks, like a lawn mower look. *B: I see, it looks like a lawn mower.* L: Look how little. Poop! *B: Poop!* L: Yesterday, when we were cooking, then then, we made spaghetti yes, we made green spaghetti, yes, yes, did we Billy? *B: Eat spaghetti.* *I was eating spaghetti for dinner.* *My lawn mower is so,* L: I am raking the grass. *I am mowing the grass.* L: Mowing grass. Raking. ……. *B: We were gardeners, weren't we?* L: Yes, but I am a ranger. *Do you know what a trapper is?* L: You can just find a trapper here. *B: No* L: Yes They catch animals. Trappas. Do you know what a trappas is? *B: Yes, it is just a thing.* L: A trapper, A grass trapper, which is just an automatic machine that mows the grass.	*F: Do you hear the voice of other people?* L: Yes, I hear them, Taa! Where is the other? *F: I want to be a gnome,* *We will be a gnome.* L: Yes! I have a green gnome hat. I've a green gnome hat. I've a green gnome hat. Gnome. Gnome. Gnome. Gnome. Gnome. This is my gnome hat. Gnome. Gnome. Gnome. Gnome. Gnome in fairyland. *F: Take the stuff.* L: Yes, pam. *F: Take the stuff.* L: Yes, Pam, pam, pam, rrrrr, Rrrrrrrrr, rrrrrr. These are our pointy hats, Rrrrrrrrrrr. Gnome Boris, are you coming? *F: Do we have to close it?* L: Yes. *F: We are here.* L: We are here. *F: No those don't go there.* *Those go close to the door.*

Table 4.4 *Continued.*

Daan (3 yrs.) (D) is playing with *three other friends(F)* in the garden (minute 2-5)	**Daan (D) is playing with *Billy (B)* on the schoolyard (minute 2-6)**
D: Look this is a duck, *F: No, it is not a duck, a duck cannot fly but this one can fly,* *I think it is a jay.* D: No, it is a fly, I think it is a, a flyer duck (they walk towards the vegetable garden). Bell pepper. Wait, I know something funny, guys, guys, I know a, come let's look at the bell peppers, if the bell peppers are very big. Bell pepper, bell pepper, here you are, bell peppers are, Oh no, bell peppers are gone. This is a zucchini. No, a cucumber. Look here are the bell peppers, guys, guys let's run away. Guys, guys, guys, guys. Here the bell peppers will come, do you know that? Go look if there is a little bell pepper. *F: yehes.* D: Come, something will grow here, yes, this water bottle is finished, finished yes. Look there, we are going high, we go high, we go measure, we go do high, we measure high the sunflower. *F: I can reach, look I can get it like this.* D: Let's look. Look. Look how high the sunflower did grow. Look there are birds. Come let's look how big is my hand. *F: My hand is also very big.*	D: Haa, come go after Billy. *B: Again, now you're going to get us* Okay. (Three kids are running after each other) D: Hahaha okay. Guys, guys, stop stop, you are going to get us. Ai, two. (Laughs and runs) Haaah. I am going to get. Ienemienemutten is de baas (sings a childrens rhyme).

Discussion

The purpose of this study was to investigate the effect of playing in a nature-based environment on young children's (2-4 years old) word use by taking language samples in two different places: the non-nature-based part of the schoolyard (e.g., paved) and the nature-based part of the school yard (e.g., green). We looked at differences in the total number of words (tw) and the total number of unique words

(tuw). Based on the state of the art, we hypothesized that the characteristics of the nature-based place would be reflected in a higher word count and a higher word diversity. Results of two repeated measures ANOVAs indicated that both the amount (tw) of words and the diversity of words (tuw) were significantly higher in the nature-based environment. These results indicate that children's productive vocabulary might be supported by nature-based places, and that this might already be the case for preschoolers who are in an important stage of their language development. In the following sections, we discuss the implications of our findings regarding our main focus: the developmental benefits of nature-based places for young children and, more specifically, the relation between the aspects of nature-based places and young children's word production.

Nature-based place, a context for using words?

Our findings indicate that children used more words in the nature-based place compared to the non-nature-based place. This could be due to the restorative function of nature for human behaviour. Both the Attention Restoration Theory (ART) and the Stress Recovery Theory (SRT) state that nature-based places are more restorative compared to non-nature-based places (Kaplan, 1995; Ulrich, 1983). Consistent with these theories, we argue that children might be able to focus their attention on a task better after a walk in a nature-based place than in an urban environment (Schutte et al., 2017). Since joint attention is a key factor in learning to use words, higher levels of attention can be the reason for the higher amount of words in the nature-based place (Tomasello, 2003). Secondly, research shows that being in nature-based places also affects well-being and involvement, both key factors for play quality (Dankiw et al., 2020; Prins, van der Wilt, et al., 2022). A child can only initiate play when it is relaxed as play asks for involvement and attention. While playing, children easily use a lot of words, since play is an excellent context for word use. Our findings are consistent with earlier research on the play-literacy connection, that show how play provides a particularly fertile context for language production, since it fosters skills that are central to language development (Quinn et al., 2018; Weisberg et al., 2013) A third possible explanation for our findings stems from the scaffolding function of nature-based places. Learning through play takes place on a continuum from child-directed activity via adult-guided to adult-directed activity. In our study, the teachers were asked not to intervene in the interaction between the children in both conditions. As a results, children were able to direct their own play actions within the nature-based place, while the place itself heightened their learning experience by playing the role of co-player, questioner or demonstrator

of new ways to interact with the place's affordances (Pyle & Danniels, 2017). This might have resulted in using more words: nature-guided play as a context for using many words.

Nature-based place: a smart place to be?

Playing in a nature-based place did not only result in a higher number of words, as our findings showed, but it also affected word diversity. When children play in nature-based places the affordances of the place are an inherent part of their play actions (Harwood & Collier, 2017; Prins, van der Veen, et al., 2022). Children experience the nature-based place as something to play with, and something that plays back. This means that the affordances of the nature-based place are part of their play narrative, their language around play. Children's attitude towards the affordances is one of curiosity and exploration (Dankiw et al., 2020). An embodied cognition perspective would suggest that the child's cognitive activity when playing is situated in the physical environment. From an embodied cognition perspective, we argue that children use the nature-based environment to hold and manipulate information. While playing, they retrieve this information as needed for their play actions and share it with their peers through verbal communication (e.g., words) (B. Hart & Risley, 2003). For instance, when a dry leaf is blown away by the wind, the child's attention is drawn towards this event, making the event hold conceptual information about the form and the colour of the leaf, in chasing the leaf. In this event, the child can, by embodied actions, gather information on the blowing of the wind and the weight of the leaf; embodied interactions such as chasing the flying leaf, catching it with the hand, and feeling the weight of the leaf. The physical environment is guiding and scaffolding the interaction, and the child might verbally guide himself with words such as: 'look, look, it's flying, the leaf can fly, I catch it, wow, here it is, the leaf'. In this way, the conceptual structure of the nature-based place is reflected in the diversity of words. The conceptual structure of the nature-based place holds information that is more diverse than the information held by non-nature-based places, and moreover the information of the nature-based place plays a role in the children's play actions whereas this is less the case in non-nature-based places. It is the difference between playing on or in a space, or playing with the place, with the place playing back (Gruenewald, 2003). For instance, in the conversation of Lucas with friend Billy (see Table 4), the grass makes them play 'eating green spaghetti' which in turn makes them think and talk about mowing the grass. This even results in the funny comparison between trapping animals and trapping grass. Furthermore, in the conversation of Daan with his three friends (see Table 4), they are measur-

ing the sunflower in the garden. A sunflower grows rapidly, so it makes sense to measure it so they can try to reach the sunflower. Without their own intervention, the sunflower 'plays back' by growing. This evokes a lot more language then when they play tag on their schoolyard and only run after each other. The function of the nature-based place points towards scaffolding, and more specifically, scaffolding word and language use.

Implications for practice

The way a teacher scaffolds word and language use is described as being attentive and responsive (Weisberg et al., 2013), posing open questions, sharing, expanding and clarifying ideas (van der Veen et al., 2017), encourage to think deeply (Hmelo-Silver et al., 2007) while providing hands on learning materials that generate knowledge (Catherine Lammert & Hand, 2023). In the same way, nature-based places scaffold diverse word and concept use.

Our findings highlight the scaffolding function of nature-based places as a context for rich language use in ECE. Findings can be of interest to early childhood teachers who wish to add a full five hours of language education a week (the average outdoor play time in Dutch ECE) to their educational practice, by using their outdoor play practice in ways that it contributes to language development. This might be of particular interest to teachers in school districts with children with language developmental concerns, for whom more intentional language education is needed.

Limitations and directions for future research

The general findings are in line with earlier studies (Cameron-Faulkner et al., 2018; Prins, van der Wilt, et al., 2022; Richardson & Murray, 2016) , which validates them and strengthens the more novel finding that nature-based places might support children's productive vocabulary, already in preschool. As our study used a relatively small sample, and only two measures, future research should use a longitudinal design to explore how playing in nature-based places supports children's language development over a longer period. As with every research, this study suffered from several limitations. First, as this was a small-scale study, caution should be used when generalizing findings to other groups. Second, the study was conducted in highly urbanized Dutch settings. As a result, cultural norms around outdoor play might have impacted the findings. However, the participants were from various cultural backgrounds. Third, the schoolyard design could have played a role in our findings. We conducted the study in two different schools with ordinary schoolyard design. Furthermore, the location did not play a significant role in the results. Finally,

the power of the study was high, indicating that thirty children was an adequate sample, which is plausible when using a within-subject design.

Conclusion

In conclusion, our study shows how playing in nature-based places supports the productive language use of preschoolers. This not only points to a pedagogical function of nature, but moreover to a language educational function of nature. Regular play time in nature-based places might improve children's productive language development and higher order thinking skills. This is particularly important for preschoolers, because higher order thinking skills and better vocabulary are the foundation of learning to read in later years (Green, 2021).

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5

Nature as a co-teacher in early childhood education

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Abstract

Playing in nature-based places supports early childhood development. In previous years, studies have shown the benefits of nature play for healthy child development, including language development. For early childhood teachers it is insightful to learn together how to develop language education in nature that is supportive of their student's language development. In this study we investigated how early childhood education (ECE) teachers developed language education in the context of nature-based places. The study took a collaborative action-based research approach and worked in communities of practice (CoP). In these communities, fifty-five teachers across five schools gathered six times. Based on the analysis of the shared conversations we defined the supportive aspects of nature-based places and related them to the expected outcomes of early childhood language education. We also described the professional changes they made to be able to teach language in nature. These changes were summarized in a model that informs early childhood educators how to include the pedagogical and linguistic function of nature-based places to work towards the outcomes of EC language education.

Introduction

Early childhood (EC) educators are interested in language education, since language skills are a predictor of their students' school success (Golinkoff et al., 2019; Pikulski & Templeton, 2004). For achieving language development goals in ECE such as vocabulary growth, children benefit from rich language learning environments (Rowe & Snow, 2020). In this study we explore the possibilities of nature-based places as language learning environments.

There is huge difference between children regarding their word knowledge when entering ECE (Golinkoff et al., 2019; B. Hart & Risley, 1995). Children from lower income backgrounds are more likely to underperform on linguistic tasks, compared to children from higher income backgrounds.

The difference is referred to as the '30-million-word gap' (B. Hart & Risley, 1995) and emerges from quality and quantity differences in the language spoken to them at home. This gap tends to grow overtime, since language development has a cumulative nature, i.e., the more words you know the more you learn, resulting in inequality of opportunities for educational success when children enter school.

Inspired by the Hart and Risley study, ECE-language programs have been developed. These programs are focused on improving cognitive skills, therefore, ECE professionals evaluate them sometimes as lacking enough room for play as context for the broader development (including literacy) of young children (Rubin et al., 1983; Golinkoff et al., 2006; Nathan and Pellegrini, 2010). These cognitive programs for EC language education copied practices and principles from formal language education in later years, such as vocabulary lessons and repeated story reading, at the cost of rich play experiences (Masek, L. R., Scott, M. E., Dore, R., Luo, R., Hirsh-Pasek, K., & Golinkoff, 2018). Moreover, studies demonstrated that it is hard to show the efficacy of these ECE language programs (Driessen, 2017; Fukkink et al., 2017; Leseman, P.; Veen, 2016). However, there is evidence that creating rich language learning environments in EC-settings can prevent educational delays (Markussen-Brown et al., 2017; Slot, 2018).

Nature-based places as language rich learning environments

Rich language learning environments expose children to high quality linguistic input: carefully chosen words, well used grammar and pronunciation, while providing opportunities for extended discourse (Justice, 2004; van der Veen et al., 2017), and opportunities to actively engage in linguistic interaction as well as passively overhear linguistic interaction from others (Deunk, 2009; Girolametto et al., 2006). Besides, adults are highly responsive to topics initiated by children and new language input

is often repeated (Girolametto & Weitzman, 2002). Rowe and Snow (2019) define language input quality, across three dimensions: 1) the quality of the language interactions, 2) the linguistic quality of the language and 3) the conceptual quality of the language.

It is noteworthy that more recent studies consider the language gap as related to the conceptual quality. According to Snow (2017), the word gap is an experience and knowledge gap. Interventions to improve word and concept knowledge that do not take the knowledge gap into account, and focus mostly on improving verbal input, are likely to fail (Lillard et al., 2013; Smith & Sheya, 2010). Based on previous studies we know that nature-based places scaffold and enrich language production (Dankiw Id et al., 2020; Prins, van der Wilt, et al., 2022). The conceptual quality and structure of nature-based places can serve as language rich environment, provided that children can explore the nature-based place, while sharing their thoughts and questions with a peer or ECE-professional (Engel, 2015; Prins et al., 2023). The conceptual quality of nature is demonstrated in the definition we use in this study: Nature-based places are environments that (1) have a surface (place) that is the basis for growth of life-forms (plants, fungi, worms) (2) provide possibilities for interacting with non-human 'persons' (plants, trees, insects), (3) who 'provide' loose materials to play with (sticks, seeds, feathers, and shells) ; (4) earth materials (water, rocks, soil) are part of nature-based environments as these elements are connected to the biosphere of the life forms and (5) weather phenomena (fresh air, rain, wind, sunshine), or seasonal phenomena (blooming, decay) are the features that constantly change the environment (events) (Prins, van der Wilt, et al., 2022). This concept richness serves as a language learning environment for language production.

How nature-based places serve as language rich environments for deep word learning

During childhood, vocabulary grows in size and in depth. Deep word learning refers to the growth of the mental lexicon: a semantic network with connections between the semantic, grammatical and phonological aspects of words. The number of connections grows when children learn new words or new aspects of words they already know (Schoonen & Verhallen, 2008). These aspects are often learned by embodied interactions during play with the objects these words are referring to. For instance the number of connections between aspects of the concept 'hammer' grows, by playing with a hammer: connections between the aspect of using the hammer, the feel of the wooden hammer handle and the weight of the iron hammer head (M. Wilson, 2002). The connections not only grow when children learn the meaning of

new words (passive vocabulary), children also need the opportunity to use these words (Langeloo et al., 2019; Tomasello, 2012). Nature-based places are sensory-rich environments that afford word and concept learning by embodied interactions. Recent studies show that nature-based places provide play experiences for the exploration of concepts, which is the basis for language development (Prins et al., 2023; Streelasky, 2019).

To date, few studies have explored nature-based places as a context for EC-language education. If nature-based places support learning language for complex concepts, this is a promising new practice to explore. Moreover, there is a need for developing new practices for language education, not only because of the importance of word and concept knowledge for school success, but also because the earlier mentioned discomfort with the strict ECE language programs.

The current study

This paper reports on a process in which we co-created a new educational practice by exploring nature-based places as a context for language education. We aimed at using EC-teachers' insights to identify the supportive function of nature-based places for EC- language education. We expected EC-teachers to reflect on the dimensions of good EC-language education (interactional quality, linguistic quality, conceptual quality) while exploring if and how nature-based environments improved the outcomes of language education. Research questions that guided this study were:

How do ECE professionals make nature-based places function as language learning environments in EC-language education?

Sub questions:

1. What aspects of nature-based places do ECE professionals experience as supportive for their practice of language education in early childhood education?
2. How do nature-based places contribute to the outcomes of language education?
3. What do ECE-professionals change in their language education when including nature-based places into their practice?

Methods

Context

The study was conducted in Dutch ECE- practices. We selected two day-care centres and three primary schools in highly urbanized neighbourhoods. In the Nether-

lands children start primary school at 4 years old. Four of these locations did not have a nature-based playground, however, they had either access to a public park, or their playgrounds contained (small) nature-based area's.

Participants

Five ECE-teams participated in the project: three primary school teams, with students between four and seven years old, and two preschool teams, with students between one and four years old. The teams, recruited through the professional network of the first author, decided to participate after a presentation on the research project. They experienced their current language education practice as too cognitive and aimed to make more of their outdoor play practice. Each team formed a community of practice (CoP), together with ECE-pedagogy and ECE-language researchers. All participants joined voluntarily in the study and signed for informed consent. Fifty-five people participated in a total of thirty meetings: six per CoP.

Table 5.1 *Members of the Communities of Practice (CoP)*

Position	N CoP members	CoP Primary school team 1	CoP Primary school team 2	CoP Primary school team 3	CoP Preschool team 4	CoP Preschool team 5
Primary school teacher	24	7	6	11		
Early Childhood Education teacher	19	2			9	8
School Manager	5	1			2	2
Internal Supervisor	4	1	1	1		1
Researchers (participating in more than one CoP)	3	1	1	1	2	2
total	55	12	8	13	13	13

Collaborative Action Research in Communities of Practice

Collaborative action research in communities of practice was used as a method to study how ECE-professionals would change their practice (Li et al., 2009; Ponte, 2002). CoPs are dynamic learning partnerships among colleagues from practice as

well as from research (Table 5.1), interacting regularly to construct knowledge on the professional practice. CoP not only refers to the partnership as a group but also to the process of *thinking together* about real-life problems they genuinely care about (Pyrko et al., 2017). Knowledge was constructed in a systematic working structure of mutual engagement, sharing of repertoires, and negotiation of the joint enterprise. This structure secured the expression of the different subjective perspectives and the possibility to question and recalibrate it, aiming for an intersubjective understanding (Peters et al., 2021).

Procedure

Three primary school teams started, with the intention to last for 18 months, starting October 2018 and ending April 2020. Every 6-8 week we gathered in a live CoP-meeting. We continued the project with two preschool teams in October 2020, but we designed each meeting with a live and an online version in mind, according to the COVID-rules in force at that time: Five meetings were held online and only one was a live meeting.

Each CoP-meeting was designed in a cyclic process of progressive insight (figure5.1): Reflection on the current practices around language education and outdoor play, followed by a moment of inspiration, consisting of sharing knowledge on didactic principles of ECE-language education. Furthermore, a nature activity to experience the function of nature-based places for (language) education. For example, CoP-members went outside during dusk to explore the quality of light and dark, or gathered around trees to explore the differences of bark. The nature activity inspired a language teaching action, performed between two meetings. For example: I will go to the botanical garden, I will tell the children a story on a snail, then the children look for snails and other critters.

Each meeting was recorded, and the actions were written on action-reflection forms. Between meetings the data was analysed by the researchers and CoP-teachers. Preliminary insights were used to develop content for the next meeting.

We reflected on the written action-reflection forms, based on the questions: What action in nature did I do with my group? Where did we go? What was my intention, what did I observe in the children? What did I observe in myself? What inspired me to act like this? What insight did I get?

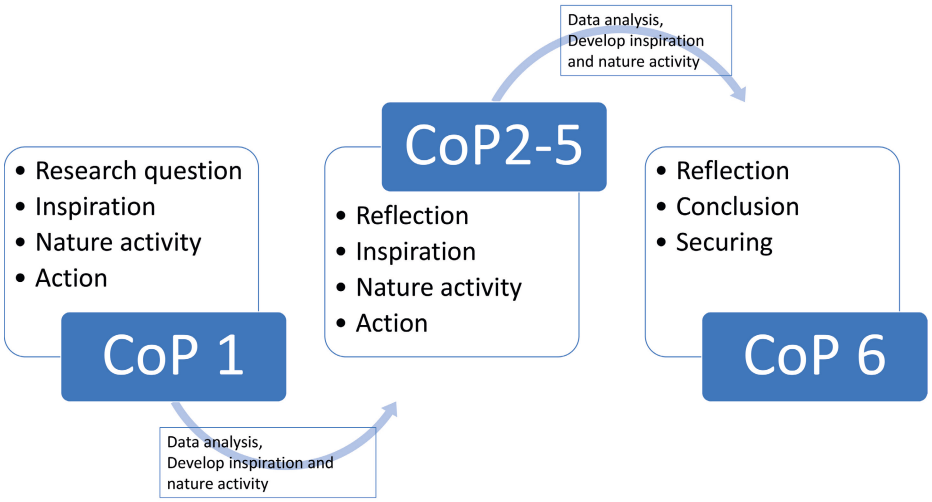

Figure 5.1 *Collaborative Action Research within Communities of practice*

Data collection

The CoP-meetings were audio recorded and transcribed verbatim. Written action-reflection forms and pictures were collected as well.

Analysis

In this study, we worked with theories in use and espoused theories of ECE-teachers. (Argyris & Schon). These theories cannot be obtained when researchers work from an a priori stipulated theoretical academic or philosophical view of the reality of professionals from practice. Therefore inductive analyses were conducted to openly explore professionals insights (Peters et al., 2021). The transcripts were coded via thematic content analysis in Atlas-ti 9 and consisted of four interrelated steps (see appendix Table 5.2).

Open coding First, we highlighted concepts that stood out in each CoP to arrive at a first set of codes to label teachers' descriptions and reflections of what they observed during their language education 'actions'.

Axial coding Subsequently, the data was explored to find patterns that could be represented by larger concepts regarding language education and concepts regarding the affording role of nature. Next, these cases were analysed by considering whether these larger concepts were appropriate for each individual case or if other concepts were needed. The cases were compared and discussed constantly, and ideas were checked against the data to avoid confirmation bias.

Selective coding Finally, the codes were combined and summarized, by selecting core components (initiatives), that showed a shared and transformed practice of language education.

Validity and reliability

To control the quality of the data, the interpretations and the consistency of the process, several strategies were used (Pyrko et al., 2017): (1) prolonged mutual engagement: researchers committed themselves to be part of a school team's CoP for at least one year; (2) replication: the researchers were part of five CoPs to be able to compare and contrast findings; (3) triangulation: researchers collected multiple forms of data: written action-forms as well as pictures, transcriptions of the conversations during CoP-meetings ; (4) reflexivity and academic literature: researchers divided their roles during the process of analysis, with two researchers working on primary analyses, and one exploring the relation between the findings and the theoretical frameworks. Five transcripts (one of each CoP) were coded by the team's supervisor. Furthermore complex fragments were discussed with two experienced supervisors, until consensus was reached and we eventually arrived at a state of saturation (Dey, 2004).

Results

The results of this study are demonstrated by answering the sub questions that guided the study. This resulted in a new theory of language education, which is the answer to the main research question.

Supportive aspects of nature-based places for early childhood language education

The supportive aspects of nature-based places can be divided in four themes related to early childhood language education and to preconditions necessary for learning in general: 1) sensory rich, 2) concept rich and 3) the living character that plays back as a play partner 4) attention restoration, free of judgement.

Sensory rich

Nature-based places are sensory rich places. Teachers observed that the students used all their senses while exploring nature's affordances. These embodied experiences were central to the learning activity.

That a rain shower can give so much joy to these guys: they are feeling the drops, tasting it while sticking their tongues out, they are running around and gather the water in their boots, it is funny to see them experience it, with all their senses (team 4).

Concept rich

Nature-based places offer interesting concepts; for instance, concepts concerning the laws of nature and the circle of life. Concepts often are dynamic, like finding out how plants grow, how the weather changes a place, where insects and birds live. Therefore, going regularly to these places helped students to try to reason about these concepts which led to higher order thinking.

'Yes, yes, first this was sand, but later it turned into mud, yes, you know, I heard that they used time and cause and effect; So I asked them: first you have sand, but what happens when you mix it with the water from the puddle, yes it is easy to stimulate them to use higher-order thinking skills, when we are in the garden.' (team 5)

Living character

Nature-based places have the power to 'play back'. This aspect made nature-play a vivid experience. The events went back and forth between the students and the place. This is obvious when we think of playing with insects or snails, but it happened as well with phenomena such as the wind. The wind also was a (living) play partner for the students.

'And when we are outside things just happen the leaves and the feathers suddenly blew away, the students gathered them back and tried to imitate the wind, they played with the wind and tried to blow like the wind.' (team 1)

Freedom and attention

Nature-based places offer a sense of freedom. The rules outside were less restrictive than when inside the classroom. This made students happy and full of energy. Added to the diversity in nature's colours, forms, and smells, this made the students more focused and less distracted. Furthermore, they had less conflicts in nature then when they played in the non-nature-based school yard, where they tend to quarrel over bikes and jumping ropes.

They have more freedom to do what they want. Because indoors they are somewhat restricted in their movements and outside they feel more freedom, yes, so they have a lot more to sense, to look at, to do, to hear, yea they can be really noisy outside,

and that helps. When we are in the classroom I always ask them to be quiet, so they are more free to talk and to act when outside.' (team 5)

Supportive aspects related to outcomes for language development.

The teachers connected the supportive aspects of nature-based places to their intended outcomes of early childhood language education (see appendix).

Learning attitude - freedom and attention, non-judgmental

Nature-based places afforded experiences of freedom. Teachers mentioned that their planned language education indoors (i.e., vocabulary activities with word cards) could be stressful for students. More specifically, shy or nervous students cannot speak 'on command'. Furthermore, it was hard for students to control the urge to use their senses during language activities. The experience of freedom got translated to freedom to talk. The embodied experience supported the act of putting it into words. Sometimes students who were too shy to talk in class, felt free to talk to animals. Furthermore, attention was mentioned as an aspect of nature-play and, attention makes it possible to understand what language and words are referring to, which supports word learning.

'Well, I listened to this girl and she said "no, I will get dirty in the sand" then I told her to just go, that it was okay to get dirty, and then I thought: wow, we have to show her mother what she is saying while getting dirty, and that she feels so free now, and that affects her talk, she feels free, and she speaks free, wow this will become a challenge.' (team 5)

Deep word learning - sensory richness

Teachers did vocabulary activities, but they openly doubted the effectiveness of these (cognitive) activities. The sensory richness of the nature-based place made learning words not only more fun, but also more 'deep'. Words learned during embodied experiences in the nature-based place were learned faster and remembered more easily; it was easier to connect a word to a meaningful embodied experience than to a picture.

'Yes, they feel a worm like that. You know, I can show them nice pictures of a worm, but they keep talking about a snake, when looking at the picture. Only after going to the botanical garden and looking for worms, they really learned the word, after holding the worms on their hands and playing with them.' (team 2)

Rich conceptual thinking- concept rich

Teachers were surprised by the rich conceptual thinking overheard during conversations of students during nature-play. They explained this by the rich conceptual structure of the natural world, which supported reasoning about complex concepts. Complex concepts afforded authentic questions, which the students tried to answer by exploring (with their senses) the real tangible world. Even when students not immediately understood the whole concept, the reasoning about it, supported their efforts to try to understand it.

'Well we looked at a picture of the earth on the computer, and they saw, of course, that it was not flat, they saw the globe and that it was not flat. But then we went outdoors, and then the kids came to ask: "why can't we see it here that the earth is round?", well that was a difficult question for me, so I asked them: "yes why can't we see it here?" And then they answered: let's go and look. And when we were in the park I heard them say "it's because they built all those buildings here and because of that everything became flat outside". Yes, that sounds very funny but I hear them reason.' (team3)

The teachers experienced the supportive character of rich nature concepts also during themed education. They discovered how students included nature elements into the theme they worked on, making it more interesting. Their experience of exploration in the garden made students inventive, brought their thinking to a higher level and translated into a richer diversity of words and sentences.

'We started to incorporate the school garden into the theme we were working on: health centres. You know last year, they only gave shots to the doll and were measuring the babies, but now, it was so funny, they told the parents to take strolls in the garden, that it was extremely healthy to go to the park with your baby. And then they took the doll pram to walk around the school garden. But they also tried to prepare creams and lotions using plants. Think about the words they used.'(team1)

Emergent literacy and phonics- living character

The teachers started with linking outcomes for oral language development to the supportive aspects of nature-based places. Next, they started to discover that nature's living character also supported aspects of emergent literacy development. They used this supportive living character intentionally, by reading books outdoors.

'*This book I would definitely take it outdoors, it is all about the wind, it is about a bike who wanted to go running outdoors, but the wind is holding him. The bike asks*

the wind to step aside, letting the bike pass. But the wind continues blowing, even harder. Then the snail comes and tells the bike to drop on the floor and start crawling. This book reads better when outdoors, where the snails and the wind are.' (team 4)

Teachers explored also the dynamic, event-like character of nature-based places to support storytelling. They discovered how nature tells stories, like books do. Story-like events that were cohesive, contained chronology, cause, and effect, afforded learning beyond individual words or concepts. Since their students experienced these events themselves, it contributed to the understanding of abstract events.

'We hung the shadow tarps for the first-time last week and then you see that the children look at something strange on the ground. We have the two triangles and a rectangle above the sandbox, so you see, they didn't necessarily all name it, but they did see the shadows on the ground. Suddenly there was something on the ground that was not there before, and they looked from above their heads thinking how come? So, it was a discovery! A valuable moment!' (team 4).

They also linked phonics activities to nature's living character.

'We went to the petting zoo where the kids imitated the cow and we found out that it was fun to work on sounds when animals make them. They paid so much attention to the sounds and discussed if they were hearing more an /u/ sound or more an /o/ sound. Even the kids for whom it is too abstract to talk about phonics in class.' (team 1)

Professional changes

Teacher leadership

The study encouraged teachers to change their practice. They started with the intention to take more ownership over their language education practice, acknowledging their own values and knowledge of early childhood language development.

'Yes, (….) we are not the organization where there is pushing on a fixed day program with every minute planned. Why can't we stand up, say, and value these moments in nature. Just go. Yes, is that a system? Is that something we forget? Or do we need more training or guidance from the VVE (ECE coaching). What will we learn from that? That is really my question, what did we do, building that entire system that we embellished. That beautiful moment must be enough' (team 4)

Language teachers, changed skills

Instead of doing planned language activities, they learned using (new) teaching skills to be able to evaluate and guide their student's language production: to engage in joint attention with their students, since nature asked for the student's attention, then following the attention, evaluating what the students meant to tell, adding words when needed.

'What I observed that I was spoiling their curiosity, by always asking them to imitate what I was teaching, without listening to them, and I did this especially with children that I considered to be behind. Now I first follow their attention, and then I add words, if they not yet know them.'(team 5)

Furthermore, they started to dialogue with the students about the concepts they were exploring. Since in nature, so many events happened without their own planning, they just could focus on the dialogue that evolved around these events. They learned to listen to children's curious questions and in answering these, using the sensory and conceptual richness of the natural world.

What I had to change: just let it happen it is never the same outside, we will learn together. One of the girls the other day said: "I will jump over you" and I answered: "then you have to jump really high", but then I saw she was jumping over my shadow and then we had this talk about shadows. (team 4)

Nature as co-teacher in early childhood language education, a new theory of practice

During the process of action research, the teacher developed the practice theory of working with nature as co-teacher. This theory is characterized by an important shift from a mostly teacher-led language learning environment to a process of the collaboration between student initiative, teacher initiative and nature initiative. Whereas the teachers used to focus on the dyadic nature of the interactions between themselves and the students, with a focus on their own input, this theory is characterized by the acknowledgment of the active participation of the nature-based place in language education. This indicates a triadic pattern of three actors: 1) child 2) teacher 3) nature (figure 5.2).

Child initiative

Nature-based places made students curious about life-forms and phenomena they encountered. Students asked authentic questions and discussed their expe-

riences. As a result, students talked more freely. Added to this, while playing in the nature-based place, group composition was more diverse which enriched the conversational patterns. Students negotiated the meaning of the environment in their play activities, talking to themselves to guide their own actions and thinking aloud.

'And in the schoolgarden, we were talking about that, we see that the children are discussing more, they were playing differently, therefore they negotiatied more with each other about the things they saw around them, but also about the features of these objects. Such as the logs, these are heavy but these not, and if they could use certain logs to carry around and to build with'(team 1).

To allow for child initiative the teachers needed to focus on students' embodied interaction with the world.

Teacher initiative

To allow for child initiative teachers own initiative was attentive, following the child's curiosity towards the phenomena of nature-based places and exploration of this environment. Subsequently they interacted with both the child and the nature-based place. Therefore, they balanced between their own plans and activities and the activities that came up out of the interaction of the student with the dynamic affordances of the environment: a slug, acorns, leaves, seeds, sand, mud, water. Teachers needed to be active and close to the children to follow their curiosity, accepting what the phenomena and materials of the nature-based place afforded. To utilize these moments, teachers needed specific knowledge about the process of concept building from embodied interactions with the physical word, instead of learning language from (only) verbal interactions.

Furthermore, a novel approach towards nature phenomena was needed. Specially towards weather phenomena or events initially evaluated as too risky. For instance, a teacher that was used to rush inside when it started to rain, now observed that the students wanted to seek a place under the shrubs to hide from the rain, which led to reasoning about the aspects of a good hiding place and how raindrops are stopped by the leaves of a shrub. To enhance these coincidental conversations the teacher needed to use interactional language skills, make room for the students' thoughts and words. 'I need put myself between brackets' he said, which meant holding back the urge to protect the children from the weather, or his own unfamiliarity with nature (getting dirty or wet, allow for risky play, be cool around a

flying bee) and instead listen to what came up between the students and nature, 'like you do with your co-teacher'.

A rich language environment was no longer characterized by a teacher's language input, but by children engaging in meaningful experiences with phenomena that caught their attention, while giving words to these experiences. They learned to trust the rich, conceptual (science) structures that nature afforded.

Nature initiative

Nature-based places had their own initiative in language education. Firstly, nature had the power of drawing children's attention. Teachers used to attract the interest of their students by their design of the learning environment. Working from this new theory of practice they did not design anything themselves. The lessons that happened were initiated by nature's phenomena.

'Like this week (...) we have this tarp above the sandpit. Well, this tarp was there also when it rained, but we have one spot in the tarp there, that spot is not waterproof anymore. And there in that spot raindrops were falling, but it was not raining at that moment. And the drops fell on the table in the sandpit. And immediately the children's attention was focused on these raindrops. And then the conversation started: where did these drops come from, it was not raining at all, in fact there was a lot of sun, how can water get collected on the tarp, and was it a hole in the tarp or was it leaking through this spot' (team 5).

Nature had its own life. This living character was narrative; events happened like in books and stories. Children listened to this narrative character and cooperated in the story. Nature was also a place to meet 'persons' (animals, plants, substances such as sand or waterdrops) and have meaningful interactions with them.

It was special to, to see that they engaged in role play by themselves, I had expected that some would, but that others would think 'well this place is less interesting' but this was not the case. All the children were busy, some started to collect sticks, while others started to build something. They were all engaged in nature play while I hadn't prepared for anything (team2).

They were collecting snails, and then I told them to let the snail walk on the back of their hand. It is funny, that they always call me, when they find the snails, and that they want me to meet the snail, and I want them to feel the snail on their hands, that they feel the slimy snails and look at them and be careful with them. A snail is not a picture but someone (team5)'

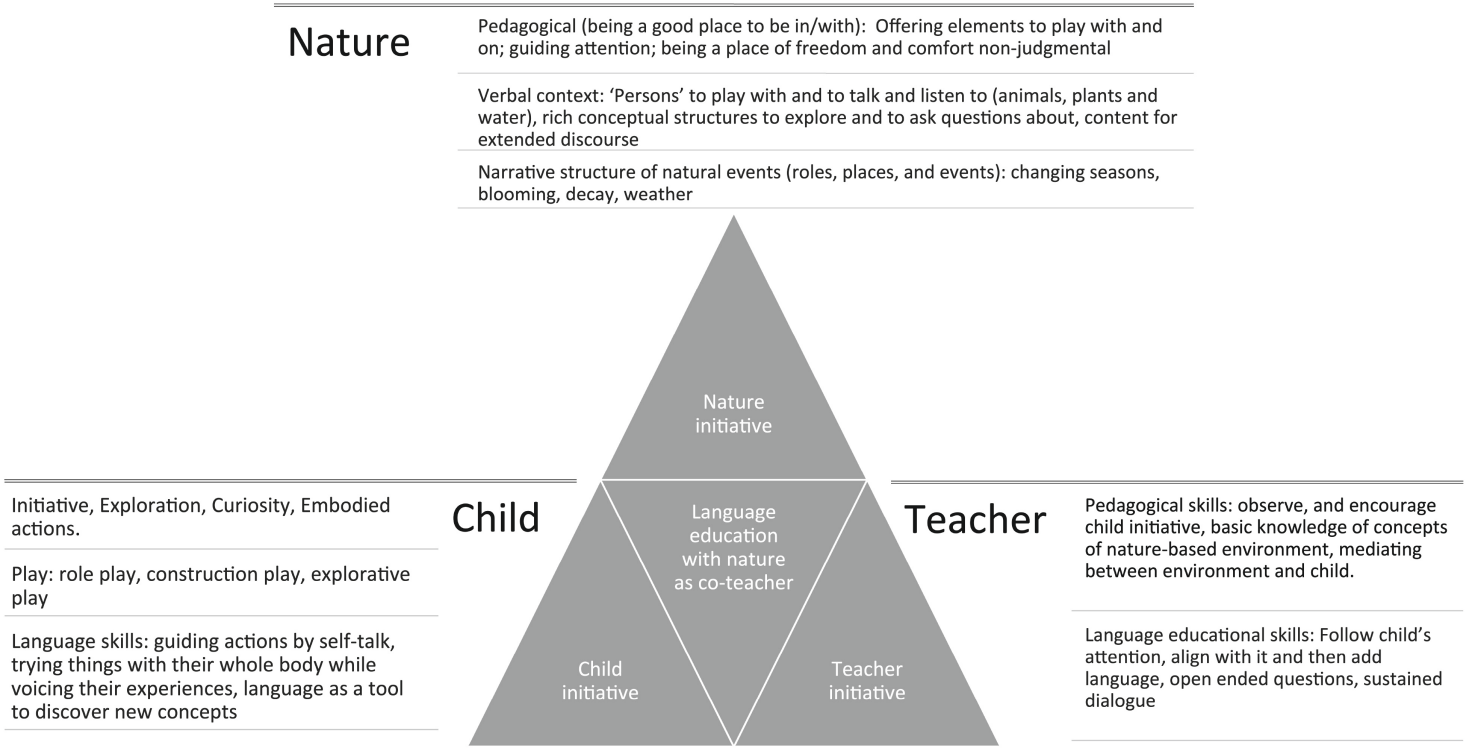

Figure 5.2 *Language education with nature as co-teacher*

The last aspect of nature's initiative was 'being a good place'. Nature afforded feelings of freedom and released stress, for students as well as for teachers. This aspect made the teachers and students more open and sensitive.

I noticed that maybe because outdoors we have less toys to distract them, that they that they, yes that there is more imaginative play (…)And for me I find it, for me, and that is not unimportant, I like it to be outside, I really like it, yes, that is really important I think. That one thinks that it is nice to be outdoors. Yes, I think that because of that I am better in guiding the children, beacuse there I am in my element, yes, I think that is important' (team 4).

Discussion

This study aimed at developing knowledge on including nature-based places in language education by exploring the supportive aspects of nature-based places for EC language teaching language, including its contribution to the desired outcomes of language education. At the same time, we explored how ECE-teachers developed a new theory of practice for their language education. The new theory was produced in a collaborative process of teams with academic colleagues and colleagues from practice, developing new forms of language education, carrying it out, and evaluating it. One of the most valuable insights of this theory is that it suggests a pedagogical and linguistic function of nature-based places. This indicates a new way of teaching language. Lately, the focus of good language education has been more on the linguistic quality of the language input and the quality of the teacher child language interactions, as a reaction to the focus on the quantity of the language following the Hart and Risley study (1995). However, Rowe and Snow (2019) also emphasize the importance of the conceptual quality of the language input in language education. In this study the teams that developed the new practice, experienced the conceptual quality of nature-based places as supportive of the verbal interactions between teachers and students. Teachers and children experienced more freedom, students engaged in meaningful embodied experiences with the elements of nature-based places, their attention was caught by nature's phenomena, and this formed the basis for verbal interaction between all participants.

The new theory of practice indicated a new way of language education that required a transformation of both the language education practice as well the practice of playing outdoors. The new theory of practice featured three dimensions. The first dimension was the discovery of the active role children have in their own language

development when they are in a place of interest to them, such as nature. This is consistent with the usage based theory of language development: language is learned by using language, therefore language development is an active process (Tomasello, 2012). Central to this active process is experience, the active interplay between child and environment. As Dewey states: "Growth is not something done to them; it is something they do." Also in play, children's leading activity during ECE, they use language as a tool to negotiate the meaning of the concepts in the physical world with their peers. In this way they construct textual representations of the concepts around them to understand the world, which is again an active process (Van Oers, 2007)

The second dimension was the transformation of the ECE-teachers' view on their role as language educator. They went from planning language moments with strict teaching strategies (i.e., interactive book reading, vocabulary teaching, and phonics activities), to becoming an active participant in triadic interactions that arise/emerge when being in nature-based places with the students. The nature based places supported this shift, consistent with the view that language education needs to be situated and grounded in rich conceptual structures to form strong conceptual networks (Neuman et al., 2011). It was new for them to offload EC-teacher responsibilities to the physical environment. At the same time, it required reinforcing or learning new verbal interaction skills, such as follow child's attention, align with it and then add language, asking open ended questions, and sustaining the dialogue when talking about the questions.

The third dimension was the most innovative: the acknowledgement of the agency of nature as an active participant in language education. It started by recognizing nature-based places as places to restore attention and relieve stress, which are basic theories within environmental psychology (Kaplan, 1995; Ulrich, 1983). Shared attention, a basic need for young children to be able to learn new words and concepts is easier to establish in nature. Furthermore this resonates with the view of the environment as the third teacher in Reggio Emilia schools (Strong-Wilson & Ellis, 2009). However, this was not only a change to paying more attention to the design of rich learning environments by the teacher, instead, it called for a transformation: collaborate with the living character of the nature-based place. Nature's pedagogical function was discovered, which is the potential to guide and scaffold children's play and language use, in other words the potential to 'play back', as well as nature's linguistic function. In addition, during this transformation the teachers discovered the children's as well as their own relationship with the non-human

world (Prins, van der Wilt, et al., 2022; Taylor & Giugni, 2012). This is in line with post humanist view that takes the agency of nature-based places seriously, finding new perspectives on how humans and nature are connected (Harwood & Collier, 2017).

Strengths, limitations and future research

To our knowledge this is the first study that aimed to develop a new theory of practice by making nature-based places function as language learning environments in EC language education. We worked in communities of practice that not only aimed at the professional development of individual professionals, but also at a collective process of knowledge construction with a view to advancing the development of the profession. This collaborative action design supported the development of knowledge that is embedded in praxis and therefore direct accessible to the professionals. Since the shared production of a new theory of language education was a process across five different teams across five different educational contexts, fifty-five professionals it seems reasonable that this theory of praxis can be extended to ECE practices on a national and international level. However, the study was not without its limitations. Although the process was across five different teams the results are based on subjective experiences. We aimed to advance from subjectivity to intersubjectivity by facilitating a shared intersubjective and critical conversation. We did so by using prolonged mutual engagement, replication, triangulation and reflexivity. The results are a product of this process.

In this study we collaborated with teams that were interested in exploring new ways of language education and motivated for outdoor learning. By way of illustration, one team rebuilt a part of their schoolyard into a school garden, all by themselves, and another team decided to green the whole schoolyard, whereas they used to have two yards, a school garden and a traditional schoolyard. It might be that for teams that are not yet acquainted with the benefits of nature-based places for educational goals, the idea of including nature-based places in language education is not so accessible. However, not all participants of the communities of practice were outdoor minded, in each team at least two members were leading in this view. Nevertheless, this shows as well that in a community of practice the principle of shared production of new knowledge makes it possible to include colleagues that are more hesitant to innovate and improve their praxis.

Given the exploratory nature of the current study, future research should focus on the longitudinal effects of making nature-based places function as language learning environments in EC language education. We might expect lasting effects of including nature in language education. It would also be interesting to compare

language outcomes of ECE settings with a nature inclusive approach to education to ECE-settings with a traditional approach to (language) education.

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Appendix: Codes

Table 5.2 *Used codes*

Codes (step 1)	Language education (step 2)	Role of nature (step 3)	Interaction patterns (step 4)
smell or taste fruits and flowers, feel elements of nature, observe insects, observe birds, talk to each other, private talk	Deep word learning, embodied	Sensory rich (feel, smell, see, balance), colours and forms	Child initiative: curiosity embodied exploration
			Teacher initiative: interactional skills: follow attention child, add words
			Nature initiative: draw attention
explore (nature) concepts, talk to each other about nature concepts, include elements of nature in construction/role- play	Rich conceptual thinking	Change (weather conditions, grow, blooming and decay) Laws of nature (gravity, floating and sinking, warming of the sun, shadows)	Child initiative: explore nature's affordances, ask questions, negotiate meaning
			Teacher initiative: sustained dialogue about nature concepts
			Nature initiative: concept richness
tell story/read book, listen to elements of nature, listen to animal sounds	Emergent literacy/ phonics	Living character plays and talks back	Child initiative: listen, connect story elements to environment, play with nature
			Teacher initiative: intentional use event-like character environment
			Nature initiative: tell stories
feel free, be happy, laugh, concentration, attention, curiosity, diversification of interaction patterns	Learning attitude	Attention restoration, acoustic quality, free of judgement	Child initiative: feel free, make noise, run around
			Teacher initiative: give room for nature and child initiative, share responsibility for wellbeing students with nature
			Nature initiative: be a good place

6

Summary and General discussion

In this summary and general discussion I reflect on how this dissertation contributed to its aims, which were threefold: first, we aimed to conceptualize the topic of the function of nature for child development to provide a knowledge base for research and practice that valued nature-based play places as a part of play quality and child development The second aim was to explore the potential benefits of play in nature for children's language production, and the third aim was to investigate how early childhood professionals can incorporate the supportive function of nature-based places into language education. I will start the discussion by providing a summary of our findings, followed by an explanation of how our findings relate to the earlier literature and our theoretical framework. Next, I will critically discuss both the significance and implications of our findings for theory and practice as well as the study's strengths and limitations. Furthermore, I provide directions for future research.

Summary of the findings

The overarching questions that guided this dissertation were:

1. How are the nature-based learning environment and language development related for children aged 2-7 years?
2. How can early childhood educators make nature-based places function as language learning environments in their language education?

In **chapter two** the research started with a systematic review of primarily qualitative studies into the supportive function of playing in nature-based places for child development. We did so to get more insight into the complex relation between nature-based places and play quality in ECE and how child development, more specifically cognitive development can benefit from nature play. This would help to answer parts of the first research question, as well as to find connecting factors for the following studies, in which I wanted to empirically investigate the relation between nature-based places and language development. By reviewing qualitative studies, I created an overview of aspects of play quality that are enabled and sustained by interactions with the nature-based place. Nature-based places afford more diversity in play categories and play attitude (wellbeing and involvement) benefits from being in nature. Moreover, nature-based places afford cognitive play, which is characterized by creativity, exploration, problem solving, and meaning making. Furthermore, nature-based places contribute to the quality of teacher-child interactions; children are perceived as being more competent which allows them freedom

to explore. Moreover, teachers reinforce children's mobility and agency towards the supportive aspects of nature.

The findings of our systematic review demonstrated how nature-based places afford play in a distinctive way, resulting in the concept of "nature play", which has outcomes for motor, social-emotional, and cognitive development. These findings are the connecting factor for the following two studies, presented in **chapter three and four**, with respectively kindergartners and preschoolers. In these two studies children played ten minutes in a nature-based place and a non-nature-based place, where language samples were taken. Next, I compared the utterances produced by children in the two environments. The findings showed that children used different language while playing in nature-based places compared to playing in non-nature-based places. Specifically, I found that in the nature-based place children are more talkative and their language was more complex, compared to the language they use in the non-nature-based place. The kindergartners produced more utterances, and the preschoolers more words. In both studies we also measured the quality of the language the children used. For the kindergartners I found that they negotiated more often in order to communicate the meaning they attributed to the objects they were playing with, in nature-based places. This made the utterances semantically more layered and complex. The preschoolers from chapter four produced more unique words which I interpreted as a measure for the quality of language production. The hypothesis, based on the findings of the systematic review, the possibility that there is a relation between the place where children play, and the quality and the quantity their language production, was confirmed.

The last study, presented in **chapter five**, helped to answer the question about how early childhood teachers can make use of the supportive function of nature-based places for language education. Since the majority of young children aged two to seven years receive ECE in some way, it is important to know how teachers develop knowledge on including nature-based places in their language education. In this study fifty-five early childhood educators across five different schools explored the supportive aspects of nature-based language teaching and learning language in early childhood. While exploring these aspects they focused on how language education in nature-based places contributed to the desired outcomes of language education. In a collaborative process in which colleagues from practice worked together with academic colleagues, they developed new forms of language education, based on the supportive function of nature for language experiences, carried it out, and evaluated it. The results of the study revealed a new theory of practice

for ECE language education. One of the most valuable insights of this theory is that it suggests a pedagogical as well as a linguistic function of nature-based places. This indicates a new way of teaching language.

General discussion

Supportive aspects of nature for language development

There are several ways in which I can explain the relation between nature and language development. In chapter two was showed how nature-play has developmental outcomes for child development, more specifically cognitive development, which we explained by the functionality of nature-based places for play and language use (Heft, 1988). The findings in chapter three and four show how language use during play is embedded in the direct play situation. During play, children talk about the play situation and the rules of the play. Play itself is an important context for language production and development, however, studies showed that the conversational setting provided by outdoor play, such as freedom in choice of activities and playmates, as well as less interaction with adults, influences the quality of the language used in that setting (Deunk, 2009; Pellegrini & Bohn, 2005). In line with these studies, the studies in this dissertation point towards the supportive function of (outdoor) play in general. However, further analysis of the findings in chapter three indicates distinctive aspects of nature-based places that account for the finding that children produce utterances with more semantic complexity. We found that children in the nature-based place not only talk about the rules and the play situation, as they do in the paved playground, but their utterances in nature refer to the physical objects and environment where they are playing. This indicates that the physical environment supports language production. In the following paragraphs I summarize the supportive function of nature-based places in five supportive aspects: attention, sensory richness, and diversity, tool use, living character and conceptual quality.

Attention

Nature has distinctive quality to influence human behaviour; nature-based places contribute to wellbeing and attention, which is in line with the stress reduction (SRT) and attention restauration theory (ART) (Adams & Savahl, 2017; Kaplan, 1995; Ulrich, 1983). However, when young children are in nature-based places, it is not only their being in nature but moreover their interaction with nature in play and their language production, that contributes to motor, social-emotional, and cognitive development. Wellbeing and attention are important preconditions for play qual-

ity. Moreover, within Tomasello's (2003) usage-based approach towards language acquisition, joint attention is also an important precondition for humans to be able to understand what words are referring to.

Sensory richness and diversity

In chapter three and four, we demonstrated how utterances in the nature-based place were used to attribute meaning to the objects of the place, according to their materiality and properties. In contrast, the materiality of the objects in the non-nature-based place was taken for granted: For instance, children did not talk about what a plastic shovel is made of, whereas they were attentive to the 'pricklyness' of a nettle. In other words, the sensory richness and the diversity of the nature-based playground enhances the semantic complexity of children's language use, since it affords the need to explore the objects to get acquainted with them, before they start to use them in their play activities. This makes the utterances semantically more layered and complex, which is in line with previous studies (Cameron-Faulkner et al., 2018; Tanya Richardson Sue Waite & Hvit-Lindstrand, 2023).

After exploring and talking about what the nature-based place actually affords, children discuss and negotiate what to do with these affordances. Furthermore, in the non-nature-based place the use of the objects is more obvious, since these are often toys which impose usage, so there is less negotiation of the meaning of the physical context needed. For instance, going down the slide or riding a bike needs less negotiation than playing in a shrub and deciding on whether it is going to act as a house or as a prison: '*this was our prison where the police locked up all the bad guys*'. This results in more language referring to the nature-based environment, which explains the relation between the supportive function of the nature-based place for the number of utterances.

Tool use

Related to aspect of the sensory richness and diversity is the aspect of tool use: the utterances in the nature-based place concerning the use of objects (loose and fixed) exceed the number of utterances that are used in the non-nature-based place, more specifically as they use the objects as some sort of tool. This indicates that the opportunity for tool use (which is also an aspect of play quality) is a key factor in explaining the differences between children's language use in the two conditions. Many utterances in the nature-based place were used to attribute meaning to the objects in the process of the evolving play activity, according to their materiality and properties. In our data, the materiality of the natural loose parts such as sticks,

stones, mud, and acorns played an important role in children's language use. Children explore the characteristics of the object or element they are interacting with, to investigate what they can do with it. This stimulates them to use semantic layering in their language. For example, during play in the nature-based place, the sturdiness of the stick is discussed in relation to its use as part of a pretend bonfire. Language is used to first explore the object and then to transform the object (loose or fixed) from 'strange' to 'familiar', from twig to bonfire.

Living character

The fourth aspect of the nature-based place that is supportive of language use is its living character. In some utterances, children appear to perceive the 'living' character of the nature-based playground as possessing a mind of its own, which draws their attention resulting in talking about it. For example, during one of the play activities, two children were discussing what to do with the plant when it was growing through the roof of their pretend house in the shrubs. This is related to how in the Reggio Emilia approach the physical environment is seen as a third pedagogue that can take on a life of its own (Strong-Wilson & Ellis, 2009). However, in the case of nature, it has a life of its own, and children relate to it.

Conceptual quality

The final aspect that makes the nature-based place a unique place to play, is its conceptual quality. Many utterances in the nature-based place referred to counting or measuring the objects children found or played with, as well as to exploring natural phenomena such as gravity or the circle of life. These utterances were only found when children were playing in the nature-based playground. Our data demonstrates that in the nature-based place children use language to predict and check the numbers or measures of the objects they use, such as sticks and pinecones. Besides, children ask questions about the circle of life of a pinecone and the use of the slope of a very small hill to roll logs downward, exploring how gravity influences speed. The conceptual quality of nature-based places might result in scientific reasoning, which is a method of asking questions about the environment. Our data showed that the nature-based playground functioned as a suitable place for scientific reasoning (Gelman, 2006; Hoff, 2006).

These five aspects of nature-based places appear to support the quality of the conversational context, resulting in more complex and diverse language, and can also explain the results of our study in chapter four. The purpose of this study was to investigate if the same relation between playing in a nature-based environment

and language use we found in kindergartners (4-7 years), could also be found in even younger children (2-4 years) who are in an important stage of their language development. In this study, we measured the difference in the total word count and the word count of unique words. We hypothesized that the supportive aspects of the nature-based place would be reflected in a higher word count and a higher word diversity. The results confirmed that also the preschoolers' productive vocabulary is supported by the distinctive quality of nature-based places.

Teaching language in nature, three dimensions

I explained the findings from chapter three and four by the five supportive aspects of nature-based places for language production. In chapter five we reported on a study that helped to answer the research question about how early childhood teachers can make use of this supportive function of nature-based places for language education. Fifty-five early childhood educators developed a new theory of practice, by exploring these five supportive aspects. The results showed how the teachers make use of the supportive function of nature-based places for language education, and how language education in nature contributes to the desired outcomes of language education. One of the most valuable insights of this theory is that it suggests a pedagogical as well as a linguistic function of nature-based places. This indicates a new way of teaching language.

Language development as an active process, driven by rich experiences in nature

The new theory of practice features three dimensions. The first dimension is the discovery of the active role children have in their own language development when they are in a place of interest to them, the nature-based place. As we found in our earlier studies, the nature-based place has many supportive aspects for play quality and language use. Moreover, this is consistent with the usage-based theory of language development: language is learned by using language; therefore, language development is an active process (Tomasello, 2012). Central to this active process is experience, the active interplay between child and the environment. As Dewey states: "Growth is not something done to them; it is something they do."(Dewey, 1916, p.47) In play, which is the leading activity of children in ECE, children use language as a tool to negotiate with themselves and with their peers the meaning of the concepts in the physical world. In this way they construct textual representations of the concepts around them to understand the world, which is again an active process (Van Oers, 2007).

Active participant in triadic interactions: child-teacher-nature

The second dimension of the new theory of practice is the transformation of the ECE-teachers' view on their role as language educators. This transformed from planning language moments with strict teaching strategies (i.e., interactive book reading, vocabulary teaching, and phonics activities), to becoming an active participant in triadic interactions that arise/emerge when being in nature-based places with the children. The nature-based places support this shift, consistent with the view that language education needs to be situated and grounded in rich conceptual structures to form strong conceptual networks (Neuman et al., 2011). It was new for the participating teachers to offload some of their ECE- teacher responsibilities to the physical environment. At the same time, this requires reinforcing or learning new verbal interaction skills from the teachers, such as following a child's attention, aligning with it and then adding language, asking open-ended questions, and sustaining the dialogue when talking about the questions (Resnick et al., 2010).

Nature as co-teacher

The third dimension of the new theory of practice is the most innovative and is somewhat similar to the results of our studies into the relation between the physical environment where children play, and their language production: the acknowledgement of the agency of the nature-based place as an active participant in language education. Over the course of the study, teachers started to recognize nature-based places as places to restore attention and relieve stress, which is in line with the attention restoration theory and the stress reduction theory (Kaplan, 1995; Ulrich, 1983). Sharing attention, a basic need for young children to be able to learn new words and concepts, is easier to establish in nature. Furthermore, acknowledging the agency of the environment, resonates with the view of the environment as the third teacher in Reggio Emilia schools (Strong-Wilson & Ellis, 2009). However, this new theory of practice not only indicates paying more attention to the design of the learning environment as a third teacher. What is more, it calls for a transformation: teachers collaborate with the living character of the nature-based place. They discover the pedagogical function of nature, which is the potential to guide and scaffold children's play and language use, in other words, the potential to 'play back'. In addition, they discover the linguistic function of nature-based places, in other words the potential to be a place for children with aspects to think with and to talk to, a place that is reflective of their initiative. These functions are based on the supportive aspects of nature-based places that we demonstrated: attention, sensory richness and diversity of the place, the opportunities for tool use, the living character and the

conceptual richness. Moreover, during this transformation the teachers discover the children's as well as their own relationship with the non-human world (Prins, van der Wilt, et al., 2022; Taylor & Giugni, 2012). This is in line with a post-humanist view that takes the agency of nature-based places seriously, finding new perspectives on how humans and nature are connected (Harwood & Collier, 2017).

Theoretical implications of the research findings

Nature has a pedagogical and linguistic function

The relation between nature and human behavior, feelings, and thoughts described by several theories within environmental psychology, such as Ulrichs (1983) stress reduction theory (SRT) and Kaplans (1995) attention restoration theory (ART). Furthermore, Gibsons (2014) affordances theory showed that the physical environment affords interactions between specific features of the physical environment and a specific user. However, in their description of the relationship between humans and nature, these theories do not include the agency of nature in describing how humans and nature relate, whereas this dissertation showed how children and nature are connected when playing together. Heft (1988) took a step by considering environments from a functional perspective and pointed towards developmental dimensions of a physical environment. Functional environments can drive development for instance by its jump-off-able, grasp-able or splash-able function. However, the functions Heft described were mostly aimed at motor development, still considering the child as the agent and nature as having functionality to drive (motor) development. This dissertation showed a shift in the discussion by moving from describing the relation between child and nature from playing in, jumping of, and learning about nature, towards playing with, talking to and knowing with nature. The ART, the SRT, the affordances theory and the functional affordances theory characterize the human (child) as the only one who produces knowledge during nature play, acting upon and transforming 'materials' into something they can use in their play narrative. This dissertation demonstrated how a play narrative is produced by the child together with nature as a play partner. Nature as a play partner, as I demonstrated, has a pedagogical dimension as well as a linguistic dimension. Play activity gets enriched by play incentives from nature as well as from teachers. We recognize the supportive pedagogical dimension by nature's function of being a place of freedom and attention, and the linguistic dimension by nature's function of being talk-to-able, talk-with-able and talk-about-able. The pedagogical and linguistic dimension of nature drive language-development. In the next two paragraphs I will

explain how the pedagogical and linguistic function of nature adds new perspectives to play theory and to theories around early childhood language education.

Nature supports rich play experiences

Not only theories from environmental psychology can explain the relation between nature and human behavior, feelings and thoughts. Play theories also explain how children's active engagement with the surrounding world (i.e., play) results in learning and development. In the context of play, children learn how to take part and contribute to the world, since play activity leads to knowledge of different aspects of the world (Bakhurst, 2009; Piaget, 2013; van Oers, 2013). An important feature of play is the use of tools. I explained how nature-based places have the unique quality of providing numerous materials that can be used as tools (Speldewinde & Campbell, 2022). However, play theories do not take into account the unique and specific function of 'nature' as a physical environment where the play takes place. Moreover, this dissertation shows how nature is not only a place but also an indivisible part of the play and has the unique quality of 'playing back'. The living character of the nature-based environment, the fact that it has a life of its own, accounts for reciprocity and diversity in children's play.

Furthermore, the theories that describe how physical environments are associated with people's feelings, thoughts and behaviors (Gibson, 2014; Heft, 1988; Kaplan, 1995; Ulrich, 1983) do not take into account a deep theoretical understanding of play for the development of young children. In the first place, the SRT and the ART focus on just being in nature, without explaining how nature guides, supports and instigates play activity. Furthermore, the affordances theory that actually describes the interactions between child and nature, tends to describe play in terms of individual play actions afforded by specific environmental features, such as a tree trunk affording jumping off. This dissertation demonstrated that the relation between the physical context of play and play activity is more complex; not an individual action afforded by a physical element in nature. Play is a mode of being and knowing in itself, play is interdependent with the human or non-human play partner. Considering the relation between nature, children and play, this relation is "*generative and becoming, in which playing (re) generates those playing*" (Rautio & Winston, 2015: 17). Nature play is being 'in it' together: child and nature.

This dissertation showed that nature affords rich interdependent play experiences that can drive development. Moreover, it showed that play in nature is an excellent communicative context for sharing concepts together during rich language experiences (K. Roskos & Christie, 2011).

Nature supports rich language experiences

There are several theories that explain how the environment supports early childhood language learning. However, most of these theories deal with the social language learning environment. These theories explain how verbal interactions both at home and at school are the primary sources from which children learn to interpret communicative intentions and understand new words (Marulis & Neuman, 2010; Tomasello, 2003). Rather than focusing on the social language environment, this dissertation demonstrated that the physical quality of the environment is also important for language production. More specifically I demonstrated how nature as play partner, supports the quantity as well as the quality of the language children use during play. I described how exploration of elements in nature leads to transforming these elements into tools that have agency and can motivate children to achieve their play goal (Bodrova and Leong, 2015; Wynberg et al., 2022). This is in line with cultural historical activity theory (CHAT). However, our research adds to this theoretical perspective by showing that nature has unique qualities as a co-teacher, since it affords materials that need to be transformed before they can be used in a specific play narrative and that natural elements have agency to transform the play narrative. The natural elements are not yet tools to play with, they transform and get transformed by using rich language.

Furthermore, I demonstrated that nature's rich conceptual structure makes children think and ask questions about it. These questions are often related to science and math concepts. As Freudentahl (1978) stated, science is a method of asking questions about the environment and mathematics is to be seen as a human activity of schematizing and dealing with quantitative and spatial relationships. The process of schematizing starts with concrete embodied interactions with quantities and spatiality. This dissertation demonstrated how the conceptual structure of nature-based places supports this interaction and leads to scientific reasoning. This is a new perspective and adds to the theory of early childhood learning environments (Berris & Miller, 2011)

Implications for practice: back to the garden

Froebel designed ECE with gardens as places for rich sensory experiences, full of stimulating characteristics to explore and to meet through active exploration, play and talk. However, due to several causes, as was explained in the introduction, these gardens as a place for self-initiated play in ECE have fallen into decline. This dissertation added new perspectives to early childhood play and learning theories

that transform our view of how nature, children and teachers can learn from each other in ECE. These new perspectives make a case for going back to the garden in ECE. Early childhood educators are key actors in transforming the way children engage in rich play and language experiences during ECE. My hope is that the findings in this dissertation encourage them to enrich their outdoor play practices by collaborating with the pedagogical and linguistic function of nature-based places for language education. This is even more important for ECE in highly urbanized areas, since children from these areas grow up with less opportunities to play in and with nature, which has consequences for their (socio-cognitive) development. In the last study, we developed a model for teachers to collaborate with nature-based places as a co-teacher for language education. Also, when teachers incorporate nature play into their outdoor play practices, where they collaborate nature, it is possible to extend the time they usually spend on intentional language education. This might be particularly interesting for teachers in school districts with children with language developmental concerns, for whom more intentional language education is needed. These children often experience stress during more traditional forms of language education (e.g., targeted vocabulary teaching, interactive book reading), whereas the pedagogical function of nature can help them to practice their language skills with more freedom, agency and attention.

Also, for urban designers who plan the design of parks and green spaces in cities, the findings of this dissertation are insightful. More specifically child friendly nature-based places should afford interactions with the nature-based place instead of functioning as a beautiful décor.

Strengths, limitations and future research

Practice based

This dissertation started with a systematic review of qualitative research into the relation between play and nature-based places. We synthesized small scale studies based in practice, that were particularly respectful of the way children interact with the world and that tried to give voice to the view of children and their children. Although this was a systematic literature review, an ethnographic approach was used (Noblit & Hare, 2012). Therefore, this systematic literature review connected seamlessly to the high ecological validity of the three empirical studies, which is a strength of this dissertation. The embeddedness in practice adds to the relevance and the meaningfulness of our findings for ECE practice.

Whereas embeddedness in practice adds to the quality of the ecological validity, it is not without its problems. Firstly, the schools that participated in the projects all had different outdoor spaces. This was mitigated by developing a clear definition of what could be considered a nature-based place, and this definition was used across all four studies. Furthermore, the findings in our studies were consistent across all the different school yards. Secondly, not only did the physical environment differ from one setting to the other, also the practice of outdoor play was different in the participating schools. However, I tried as much as possible to preserve the daily context the children were used to, to keep the context predictable for them. Moreover, the results of the ANOVA in our third study did not demonstrate that location played a significant role in the results.

The last study in this dissertation reported on the process of co-creating new forms of education with early childhood teachers. The results, a theory of practice for teaching language in nature, are based on subjective experiences. Again, this adds to the meaningfulness of the study but has also limitations. In this process we aimed to advance from subjectivity to intersubjectivity by facilitating a shared intersubjective and critical conversation. We did so by using prolonged mutual engagement, replication, triangulation and reflexivity across five different teams with 55 professionals across five different educational contexts. We defined nature-based places in such a way that they can be recognized all over the world as places where children play. Also in most cultural communities, play is a major aspect of children's life (Roopnarine, 2012), which makes it reasonable that our new theory of praxis can be extended to ECE practices on a national and international level.

Nature and Novelty

Although there are exceptions, in most countries, nature play in ECE is a less common practice than outdoor play in a regular schoolyard. Certainly, novelty of playing in a new physical environment might have influenced our findings. However, we selected nature-based places that were familiar to the children although they were not used to playing there as much as they were in the non-nature-based school yards. Yet, novelty will always be an added feature of nature-based places, since the dynamics of nature-based places make them often be experienced as new, for instance, when a rain shower adds puddles to the place, or the sun ripens the strawberries in the vegetable garden, whereas man-made places are built to be sturdy and secure and designed for remaining intact, regardless of the weather influences.

Multiple methods, sequential design

Another strength of this dissertation is how its four studies are built upon each other, using qualitative as well as quantitative methods. I started by systematically reviewing the literature to explore a rather unstudied phenomenon: the relation between language production and play in nature. Since most of studies into this phenomenon were small-scale qualitative studies, I took a meta-ethnographic approach (Nye et al., 2016). The findings of this systematic review provided us with a useful resource for our following empirical studies. The first empirical study was an explorative mixed methods study that demonstrated the relation between language use and nature-play for children aged 4-7 years. This made me curious to replicate our findings with preschoolers who are in an even more important phase of their language development. In this study we used a quantitative method that demonstrated with more precision the relation between the quality (diversity) and quantity of the used words during nature-play, compared to play in a traditional paved schoolyard. These two studies were complemented with a study using an action research approach in communities of practice, in which we developed our new theory of practice for teaching language in nature-based places in close collaboration with teachers. This made it clear that the new phenomenon was recognized and validated in practice. The use of multiple methods and research approaches in our studies helped to understand the relation between language use and the physical environment from different perspectives, creating a holistic view, in which the findings of each of our four studies can help to illustrate and or explain the results of the other (McKim, 2017).

Future research

Suggestions for future research centre around the following themes: 1) Better understanding of the supportive function of nature-based places for early child development, with a focus on cognitive developmental outcomes of nature-play, 2) Longitudinal effects of nature-play in ECE on outcomes of language education, and 3) Taking the agency of the nature-based environment in the play of young children seriously. When studying the relation between nature and childhood development, we then might find new perspectives on how humans and nature are connected.

Our findings are part of the broader field of the benefits of nature for people's behavior. Most of the research on the supportive function of nature for child development focused on (mental) health issues. This could be due to the two leading theories on the relation between nature and human behavior, SRT and ART, which focus on stress reduction and attention restoration. In addition, the primary view

of the function of outdoor play in ECE is mostly relaxing from the learning experiences indoor. The findings of this dissertation suggest a supportive function of nature-based places for cognitive development. Future research into the benefits of nature for ECE could take into account that nature has 'co-teacher quality' and focus on learning outcomes of playing in nature, for instance outcomes for reading or math. Furthermore, it would be interesting to shift the research focus from the benefits of spending time in nature during recess, towards intentionally spending more time in nature during other parts of the daily education programs, such language education and math.

Early childhood educators together with researchers could develop programs in which children get the opportunity to spend not only an hour a day playing in nature, but instead spend half a day or even a whole day in nature with the intention of whole child development. Collaborative action research in communities of practice is a method to design education that is at the same time practice based and evidence informed. These teams should (also) focus on the cognitive developmental outcomes of playing in nature in ECE.

The second theme for future research derives from the promising results of this dissertation for language use during nature play. We can expect lasting effects of playing in a natural environment on children's language development, since using more language is expected to have impact on the overall outcomes of language education in early childhood, such as a rich vocabulary. This connects to Tomasello's idea of language acquisition as usage-based (Tomasello, 2003). It would also be interesting to compare language outcomes of ECE-settings with a nature inclusive approach to education to ECE-settings with a traditional approach to (language) education.

In addition, it would be interesting to further investigate what parts of language education benefit the most from playing in nature. In the process of developing the new theory of practice for language education we found that the quality of the language learning experience was enhanced by the nature-based environment while at the same time we found aspects of linguistic quality in nature. Outcomes for emergent literacy are traditionally achieved in the context of books, letters, pens and paper. However, children construct meaning in places that are meaningful for them, and these may differ from the traditional places and props that are used for early literacy development (Daniels, 2021). It would be interesting to investigate further how using the linguistic quality of nature-based places can support literacy development.

The last theme for future research that I suggest, originates from the question raised in this dissertation on how children relate to a nature-based place while playing there. In a western view of nature-based environments we tend to look mostly at the human perspective of interaction with the nature-based environment. Play research focuses on how children play with 'objects' as tools, but it needs to be complemented with the special character of nature as a living place, that has agency in the interaction with the playing child. Likewise, Gibsons (2014) affordances theory views the environment as a place that affords experiences and activities. However, this theory is not sufficient to move beyond individual play actions. This dissertation shows that children experience nature as something that "plays back", which points to a more reciprocal relationship with nature. Future research could benefit from a post humanist view of this relationship (Harwood & Collier, 2017; Taylor & Giugni, 2012). Taking the agency of the nature-based environment in the play of young children seriously, we might find new perspectives on how humans and nature are connected.

General conclusion: Nature is a smart place to be

This dissertation focused on the supportive function of nature for children's language development in ECE. I started with the question if only poets like Guido Gezelle ascribed linguistic quality to nature, or that also in ECE 'flowers can speak, and herbs can be polite'. In conclusion, this dissertation's overarching questions concerning the possible relation between nature as a physical play environment and language development in ECE, and the question how early childhood educators can make nature-based places function as learning environments for language, are answered by the results of our studies. The results of our systematic review demonstrated that nature-based places are places that are supportive of children's play quality, and that play quality and language use are related. This was confirmed by two empirical studies with almost 50 children aged 2-7 years, showing that children are more talkative in nature-based places than they are in non-nature-based places. Besides, their language in these places is more complex and diverse. I explained the relation between language and nature by the five supportive aspects of nature-based places for language use that we found: attention, sensory richness and diversity, opportunities for tool use, living character and conceptual quality. In addition, our study with 55 professionals from ECE showed how these professionals transformed their language educational practice, using the pedagogical function of nature. Nature guided and supported children's play and meaning making processes, specifically when the teachers collaborated with the living character of

the nature-based place. This dissertation demonstrated that nature supports rich language use. In other words, nature is not only a healthy place but also a smart place to be.

A

Appendices

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Samenvatting (Summary in Dutch)

Mij spreekt de blomme een tale
Mij is het kruid beleefd
Mij groet het altemale
Dat God geschapen heeft
(Guido Gezelle)

Dit proefschrift richt zich op de ondersteunende werking van spelen op natuurrijke plekken voor de ontwikkeling van jonge kinderen in het voor- en vroegschoolse onderwijs. Met het gedicht van Gezelle in mijn gedachten heb ik me afgevraagd: Heeft de taal van bloem en kruid ook invloed op de taalontwikkeling van jonge kinderen? In het proefschrift heb ik gewerkt aan drie doelstellingen: ten eerste wilde ik de functie van natuur voor de ontwikkeling van kinderen conceptualiseren. Zo ontstaat er een kennisbasis voor het onderwijsonderzoek en de onderwijspraktijk, die inzicht geeft in de bijdrage die natuurrijke speelplekken kunnen hebben voor spelkwaliteit en de ontwikkeling van kinderen. Ten tweede wilde ik de mogelijke voordelen van spelen in de natuur specificeren voor de cognitieve ontwikkeling van kinderen, waarvan de taalontwikkeling een onderdeel is. Ten derde wilde ik onderzoeken hoe professionals in de voor- en vroegschoolse educatie de ondersteunende functie van natuurrijke plekken voor de cognitieve ontwikkeling van kinderen kunnen integreren in hun taalonderwijs.

De overkoepelende vragen die het onderzoek in dit proefschrift richting gaven, waren:

1. Hoe zijn de natuurrijke leeromgeving en de taalontwikkeling van kinderen in de leeftijd van 2-7 jaar met elkaar verbonden?
2. Hoe kunnen leraren in de voor- en vroegschoolse educatie natuurrijke plekken laten functioneren als taalrijke leeromgevingen in hun taalonderwijs?

Het proefschrift start met een systematische literatuurstudie van voornamelijk kwalitatieve studies naar de ondersteunende functie van spelen op natuurrijke plekken voor de ontwikkeling van kinderen. De literatuurstudie gaf ons inzicht in de complexe relatie tussen natuur en spelkwaliteit in de voor- en vroegschoolse educatie. Daarnaast wilden we inzicht krijgen in hoe de ontwikkeling van kinderen, meer specifiek hun cognitieve ontwikkeling, kan profiteren van natuurspel. Met deze inzichten wilden we een deel van de eerste onderzoeksvraag beantwoorden

en we wilden aanknopingspunten vinden voor de volgende studies. In die studies wilde ik de relatie tussen natuurrijke plekken en taalontwikkeling empirisch onderzoeken. De systematische literatuurstudie hielp ons om een overzicht te maken van aspecten van spelkwaliteit die direct samenhangen met buiten zijn in de natuur en aspecten van spelkwaliteit die samenhangen met de interacties van kinderen met de natuurrijke plek. Natuurrijke plekken zorgen ervoor dat de spelattitude (welzijn en betrokkenheid) verbetert en daarnaast leveren ze diversiteit op in hoe kinderen er spelen. Bovendien bevorderen natuurrijke plekken cognitief spel, dat wordt gekenmerkt door creativiteit, verkenning, probleemoplossing en betekenisgeving. Verder dragen natuurrijke plekken bij aan de kwaliteit van de interacties tussen leerkracht en kind; kinderen worden buiten door hun leraar als competenter gezien dan als ze deelnemen aan het onderwijs binnen en dat zorgt ervoor dat ze vrijheid en durf ervaren om op verkenning uit te gaan. De natuur ondersteunt en stimuleert leraren om de kinderen vrijer te laten en ze meer vanuit eigen initiatief te laten spelen. De leraren zien dat de spelkwaliteit hoog is, zonder dat zij zelf het spel verrijken, de natuurrijke omgeving ondersteunt en verrijkt het spel.

De bevindingen van onze systematische literatuurstudie toonden aan hoe natuurrijke plekken spel op een onderscheidende manier mogelijk maken, daarmee ontwikkelden we het concept van "natuurspel". Dit specifieke spel kenmerkt zich door interacties met alles wat de natuur te bieden heeft, en het leidt tot uitkomsten voor motorische, sociaal-emotionele en cognitieve ontwikkeling. Deze bevindingen vormen de basis voor de volgende twee studies, met respectievelijk kleuters en peuters. In deze twee studies speelden kinderen tien minuten in een natuurrijke plek en tien minuten op een gewone betegelde speelplaats, waarbij we hun taal opgenomen hebben op voicerecorders, die verstopt zaten in een zakje op hun speelhesje. Vervolgens vergeleken we de taaluitingen van de kinderen in die twee verschillende speelomgevingen. De resultaten toonden aan dat kinderen andere taal gebruikten tijdens het spelen op natuurrijke plekken in vergelijking met hun taal tijdens het spelen op de betegelde speelplaatsen. Wat waren die verschillen? We vonden dat kinderen die op de natuurrijke plek spelen spraakzamer zijn, in vergelijking met hun taaluitingen op de betegelde speelplaats. De kleuters gebruikten meer zinnetjes, en de peuters meer woorden. In beide studies hebben we ook de kwaliteit van de taal die de kinderen gebruikten gemeten. Voor de kleuters vonden we dat ze vaker met elkaar gingen onderhandelen over de betekenis die ze wilden toekennen aan de elementen uit de natuur waarmee ze spelen in natuurrijke plekken. Dit maakt de uitingen semantisch gelaagder en complexer. In de studie met de peuters zagen we

dat ze niet alleen meer woorden gebruikten maar ook meer verschillende woorden, wat we interpreteerden als een maatstaf voor de kwaliteit van hun taalproductie. De hypothese, gebaseerd op de bevindingen van de systematische literatuurstudie, dat er een relatie bestaat tussen de kwaliteit van de plek waar kinderen spelen en de kwaliteit en kwantiteit van hun taalproductie, werd bevestigd.

De laatste studie die we voor dit proefschrift hebben uitgevoerd, hielp bij het beantwoorden van de vraag hoe leraren en professionals in het voor- en vroegschoolse onderwijs gebruik kunnen maken van de ondersteunende functie van natuurrijke plekken voor taalonderwijs. Omdat de meeste jonge kinderen van twee tot zeven jaar naar de kinderopvang of de peuterspeelzaal gaan en daarna starten in groep een van de basisschool, is het belangrijk om samen met leraren kennis te ontwikkelen over het leren van taal op natuurrijke plekken om dat te kunnen gebruiken in het taalonderwijs. In deze studie onderzochten we samen met vijfenvijftig leraren en professionals, die werkten op vijf verschillende scholen, de ondersteunende aspecten van de natuur voor het taalonderwijs. Tijdens het onderzoeken van deze aspecten richtten deze leraren zich op de bijdrage van het spelen op natuurrijke plekken aan de opbrengsten van taalonderwijs. In een samenwerkingsproces waarin de leraren samenwerkten met academische collega's, ontwikkelden ze nieuwe vormen van taalonderwijs, gebaseerd op de ondersteunende functie van natuur voor de taalontwikkeling. Dit onderwijs werd uitgevoerd en samen geëvalueerd. De resultaten van de studie onthulden een nieuwe praktijktheorie voor taalonderwijs in de voor- en vroegschoolse educatie. Een van de meest waardevolle inzichten van deze praktijktheorie is dat het laat zien dat de natuur zowel een pedagogische als een linguïstische functie heeft in het voor- vroegschoolse onderwijs, een inzicht dat het huidige taalonderwijs kan vernieuwen en verrijken.

Dankwoord (Acknowledgments in Dutch)

Ik weet nog goed dat ik in de trein van Rotterdam naar Leiden een telefoontje kreeg van Dieuwke Hovinga, lector van het lectoraat Natuur en Ontwikkeling Kind, met de felicitatie dat ons onderzoeksvoorstel 'Hoofd Schouders Knie en Taal' was goedgekeurd. Eerlijk gezegd schrok ik er een beetje van. Nu moest ik het ook echt gaan doen, zou me dat wel lukken? Ruim zes jaar verder, ben ik blij ik dat het is gelukt en realiseer ik me hoeveel mensen daar een bijdrage aan hebben geleverd. Ik wil hen hier bedanken:

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About the author

Jannette Prins (1969) studied African Linguistics at Leiden University and received her master's degree in 1993. She studied at the academy for Teacher Education Rijn-Delfland and received a bachelor's degree in primary education in 1995.

Between 1995 and 2001 Jannette was a primary school teacher at 'de Kinderkring' in Woubrugge, teaching grades one through eight. In 2001 she started as a teacher-supervisor at 'De Weerklank', a school for children with specific language impairment (SLI) and/or hearing difficulty in Leiden. She supervised and supported the process of including children with special educational needs in regular schools. These special children showed her that language teaching in primary school could benefit from a less verbal and cognitive approach. These children needed educational experiences to make it possible to link (abstract) sound structures (words, and sentences) to abstract concepts. To reach this goal she had to be inventive in materializing abstract concepts, and she often used natural materials for this. Some of these children also had a special relationship with their pet. These teaching experiences formed the first steps towards the ideas in this dissertation.

In 2011 Jannette started as lecturer language education at Thomas More University for applied sciences, faculty of education. In 2012 she started as a member of the research group Nature and Child Development, a shared research group from Thomas More University and Leiden University for applied sciences, in addition to her work as lecturer language education. In 2017 Jannette received a grant from the Dutch organization for practice-based research SIA (Raak-Pro/NWO) for her research proposal 'Hoofd, schouders knie en TAAL' (Head, shoulders, knees and tongue). In 2023 Jannette became member of the management team of Thomas More University, as the leader of the practice-based research program.

Knowledge dissemination

Professional Publications

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‘Mij spreekt de blomme een tale’
‘To me the flower tells her story’
(Guido Gezelle)