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Nature as a Co-Teacher in Early Childhood Language 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. The aim of this study is to investigate how early childhood education (ECE) teachers make nature-based places function as language learning environments in EC language education. The study took a collaborative action-based research approach and worked in communities of practice (CoP). In these communities, 55 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 teachers how to include the pedagogical and linguistic function of nature-based places to work towards the outcomes of EC language education.

Keywords Early childhood education · Language development · Nature-based environment

Introduction

Playing in nature-based places supports early childhood development. In previous years, reviews have shown the benefits of nature play for healthy child development, including language development (Dankiw Id et al., 2020; Prins et al., 2022). Early childhood (EC) teachers are interested in language development, since language skills are a predictor of their students' school success (Golinkoff et al., 2019; Pikulski & Templeton, 2004). In this study we explore the benefits of nature-based places for EC language education. Nature-based places are environments where living elements grow in a biodiverse surface, with loose natural materials (for example sticks and feathers) and water and sand to play with. Weather and seasonal influences are part of these nature-based places.

A central issue in EC language education is the large variety among children in their word and concept knowledge, when entering early childhood education (ECE). Children from lower income backgrounds are more likely to underperform on linguistic tasks, such as vocabulary and concept knowledge, compared to children from higher income backgrounds. The difference is sometimes referred to as the '30-million-word gap' and emerges from qualitative and quantitative differences in the language spoken to them at home (Hart & Risley, 1995). Although there is controversy around the number of the gap, 30 million words is probably an exaggeration, the differences between children are real (Gilkerson et al., 2017). Moreover, this gap tends to grow over time, 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 (Golinkoff et al., 2019; Hart & Risley, 1995).

To prevent educational inequality and to support ECE teachers to deliver high quality language education, specific ECE language programs have been developed, see for example Chambers et al. (2016). There are several problems with these language programs. First, ECE-teachers evaluate

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them as being too focused on academic skills, lacking enough room for play as context for the broader development (including literacy) of young children (Hirsh-Pasek et al., 2008). For instance, practices and principles from formal language education in later years such as vocabulary lessons and repeated story reading were copied, at the cost of rich play experiences. Second, studies evaluating Dutch ECE programs demonstrated that it is hard to show the efficacy of these ECE language programs (Driessen, 2017; Fukkink et al., 2017).

Rather than the language programs, ECE teacher's interactional skills are related to the outcomes of EC language education (de Haan et al., 2013). Countless studies demonstrated that connected conversations between children and their teachers and caregivers, in which they share attention on topics that are of interest to the children, are the center of learning language (Golinkoff et al., 2019; Tomasello, 2003). It is worth noting that Cameron-Faulkner et al. (2018) showed that a natural environment supports the connectedness and responsiveness of parent–child conversations and in our own research we demonstrated that natural environments support the semantic complexity in children's language production, and support talking about complex concepts, since the conversations are connected to what they experience in the natural environment, for example, they talk about growth or gravitation (Prins et al., 2023).

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 in collaboration with EC teachers, 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 research question that guided our collaborative action research was: How do ECE professionals make nature-based places function as language learning environments in EC language education?

Literature Review

How Nature-Based Places Serve as Language Rich Learning Environments

Rich language learning environments consist of exposing children to high quality language input. Rowe and Snow (2020) define language input quality, across three dimensions. The first dimension is the quality of the language interactions. During high quality language interactions, adults are highly responsive to topics initiated by children and new language input is often repeated. Based on previous studies we know that nature-based places promote connectedness both to the physical surroundings as well to the people, which affects the interactional quality of the language (Cameron-Faulkner et al., 2018; Weinstein et al., 2015). Furthermore, children talk with adults and their peers on topics provided by the nature-based place (Cameron-Faulkner et al., 2017; Norling & Sandberg, 2015; Prins et al., 2022).

The second dimension mentioned by Rowe and Snow (2020) is the linguistic quality, which refers to carefully chosen words and well used grammar and pronunciation. Based on previous studies we know that nature-based places scaffold and enrich student's language production (Dankiw Id et al., 2020; Prins et al., 2022). In addition, a recent study showed that noise levels during outdoor learning sessions are lower than indoor ones, which makes it easier for children to understand teacher's grammar and pronunciation (Goldenberg et al., 2024).

The third dimension of language input quality is the conceptual quality of the language, which is reflected in in opportunities for extended discourse with children actively engaging in linguistic interaction (Girolametto et al., 2006; Justice, 2004; van der Veen et al., 2017) on topics that challenge children's high order thinking skills, skills that require reasoning and establish connections between concepts. The conceptual quality and structure of nature-based places is accessible to children provided that they can explore the nature-based place, while sharing their thoughts and questions with a peer or EC teacher (Engel, 2015; Prins et al., 2023). For instance, in nature-based places children talk about math and science concepts such as the length and weight of the sticks and feathers they are playing with, or about the circle of life when they find acorns or a dead critter. 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), and (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. (5) Weather phenomena (fresh air, rain, wind, sunshine), or seasonal phenomena (blooming, decay) are the features that constantly change the environment (events) (Prins et al., 2022).

How Nature-Based Places Serve As Language Rich Environments for Deep Word Learning

According to Snow (2017), the central issue of the word gap is an experience and knowledge gap. Interventions to close the gap should focus not only on verbal input quality, but rather focus on closing the knowledge gap. (Lillard et al., 2013; Smith & Sheya, 2010). Vocabulary knowledge is a

complex construct. 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; Westby, 2017). These aspects are often learned by embodied interactions during play with the objects these words are referring to (Ionescu & Ilie, 2018). 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 (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). Back and forth conversations during embodied interactions between adult and child are at the center of deep word learning (Ionescu & Ilie, 2018; Rowe & Snow, 2020). Nature-based places are sensory-rich environments that afford word and concept learning by embodied interactions. Nature-based places afford learning of a whole range of concepts, often connected to STEM education. For instance mathematical ideas about numbers, patterns and space are supported by play in nature-based places (Speldewinde & Campbell, 2022). Recent studies show that nature-based places provide play experiences for the exploration of these concepts, while supporting the use of these words in the conversation, which is the basis for language development (Prins et al., 2023; Streelasky, 2019).

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 EC teachers make nature-based places function as language learning environments in EC language education?

Sub questions:

1. What aspects of nature-based places do EC teachers 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 EC teachers change in their language education when including nature-based places into their practice?

Our findings point to a new theory of practice for EC language education in nature-based places.

Methods

Context

The study was conducted in Dutch ECE contexts. We selected two childcare centers and three primary schools in highly urbanized neighborhoods. In the Netherlands children start primary school at 4 years of age. In the Netherlands we do not work with a national curriculum. We work with a set of intended outcomes for ECE, and each school has the responsibility and freedom to develop a curriculum that yields these outcomes. One of the locations did have a school garden as well as a non-nature-based playground, with a climbing structure and a sandpit. Two locations had a non-nature-based playground with a climbing structure and a sandpit; to explore a nature-based place, they went to a public park within walking distance. The playground of the childcare centers was mostly non-nature-based but also contained (small) nature-based areas.

Collaborative Action Research in Communities of Practice

Collaborative action research in communities of practice was used as a method to study how EC teachers would change their practice (Li et al., 2009; Ponte, 2002). Collaborative action research is characterized by its focus on answering practical questions of teachers or schools in a collaboration between colleagues from practice and colleagues from research (Table 1). To be able to carry out collaborative action research Communities of Practice (CoP) are formed. 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 (Platteel et al., 2010; Pyrko et al., 2017). CoPs are learning partnerships, interacting regularly to construct knowledge on the professional practice.

Knowledge was constructed in a systematic working structure of mutual engagement, sharing of repertoires around language education, reflection on, and negotiation of the collaborative effort to develop professional insights on language education in nature. This structure secured the expression of the different subjective perspectives and the

Table 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

possibility to question and recalibrate it, aiming for an inter-subjective understanding (Peters et al., 2021).

Participants

Five ECE-teams participated in the project: three primary school teams, with students between 4 and 7 years of age, and two preschool teams, with students between 1 and 4 years of age. The teams were recruited through the professional network of the first author, after a presentation on the research project. We presented the research project to seven teams and five decided to cooperate in the research project. During this presentation these teams were motivated to cooperate in the project because they wanted to innovate their current language education practice towards a more play-based practice and were also interested in making 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 provided informed consent. 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). Fifty-five people participated in a total of 30 meetings: six per CoP.

Procedure

The research project was intended to last for 18 months. Three primary school teams started in October 2018. Every 6–8 weeks we gathered in a live CoP-meeting. However, due to the COVID pandemic we stopped temporarily, and finished the CoP's with the primary school teams in July 2020. The last two meetings were held online. 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 process of progressive insight (Fig. 1). We started with a reflection on the current practices around language education and outdoor play, followed by a moment of inspiration, consisting of sharing

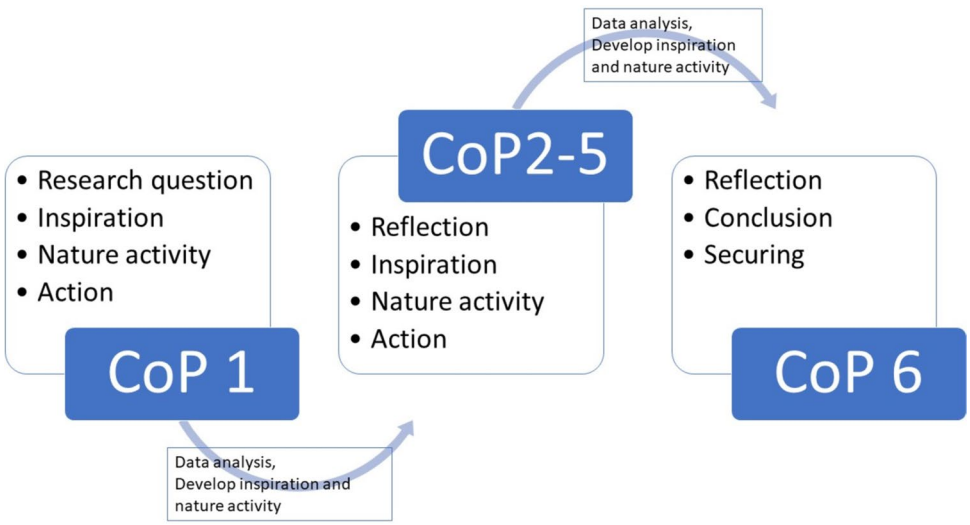

Fig. 1 Collaborative action research within communities of practice

knowledge on didactic principles of ECE language education. Furthermore, we engaged in 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 start the day outdoors (during wintertime school starts when it is still dim) I'll light a lantern and ask the children to sit down, and I'll read the story of the owl that was afraid of the dark.

Each meeting was recorded, and the actions were written on action-reflection forms. Between meetings the data was analyzed 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 insights did I get?

Data collection

The CoP-meetings were audio recorded and transcribed verbatim. Written action–reflection forms and pictures were collected as well. The action–reflection forms and pictures guided the conversations during the CoP meetings. Since they showed the intended actions (written on the forms) and the actual actions (as seen in the pictures) they were used background information for the transcripts.

Analysis

In this study, we worked with espoused theories and "theories-in-use" of EC teachers (Argyris & Schon, 1992; Ruijters, 2013). Espoused theories and "theories-in-use" are both practice theories. Espoused theory refers to the worldview and values that people believe they work from. "Theory-in-use" refers to the worldview and values reflected in the behaviors that drive their actions. Reflection on the gap between these two makes room for learning new behavior. 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 (Appendix, Table 2).

For the first step, open coding was applied by highlighting concepts that stood out in each CoP to arrive at a first set of codes to label teachers' descriptions of what they observed during their language education 'actions' (Appendix, Table 2, step 1).

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 analyzed 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 (Appendix, Table 2, step 2 and 3).

Finally, by applying selective coding, the codes were organized, combined and summarized, by selecting essential insights into new categories components (initiatives), that showed a shared and transformed practice of language education (Appendix, Table 2, step 4).

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 1 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, including written action-forms as well as pictures and 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).

Findings

We present our findings in four steps: First, we show the four supportive aspects of nature-based places for language learning, that characterized nature-based places according to the teachers. Second, we show how the teachers connected these aspects to expected outcomes of EC language education. Third, we show the professional changes the teachers made to their practices. Finally, we summarize the process in a new theory of practice.

Supportive Aspects of Nature-Based Places for Early Childhood Language Learning

The supportive aspects of nature-based places, in terms of how they afford language learning, can be divided in four themes: (1) sensory rich, (2) concept rich, (3) the living character that plays back as a play partner, and (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. They appeared to make students happy and full of energy. The rules outside were less restrictive than when inside the classroom. Added to the diversity in nature's colors, 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, because of their scarcity, whereas the natural elements were more abundant.

> *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 related the four supportive aspects of nature-based places to their intended outcomes of early childhood language education: (1) deep word learning, (2) conceptual thinking, (3) emergent literacy and phonics, and (4) learning attitude (Table 2, appendix).

Deep Word Learning: Sensory Richness

In reflecting on their usual vocabulary activities, the teachers openly doubted the effectiveness of these activities, for instance working with word cards. In contrast, they experienced the sensory richness of the nature-based place with the students, which 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. Complex concepts afforded authentic questions, which

the students tried to answer by exploring (with their senses) the real tangible world. Even when students did not immediately understand the whole concept, the reasoning about it, with their peers and teachers, 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.' (team 3)

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 centers. 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.'(team 1)

Emergent Literacy and Phonics: Living Character

The teachers started to experience the supportive aspects of nature for language production, such as learning to use new words and concepts. However, by getting more creative 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)

Next, the teachers explored 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)

To their own surprise they were also able to link 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)

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 teachers observed that the experience of freedom got translated to freedom to talk. The embodied experiences with the nature-based place 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, and the teachers also noted how enhanced attention made it possible to understand what language and words are referring to, which supported 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)

Professional Changes

Teacher Leadership

The study encouraged teachers to evaluate what changes they made to their practice, to become better language teachers. The first step they took was taking 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 (early childhood education 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

The second step was, instead of doing planned language activities indoors, going to nature-based places, using (new) teaching skills to be able to evaluate and guide their student's language production. For instance, 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, when playing outdoors, 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 last coding step, i.e. selective coding, the findings showed the essential insights of the whole collaborative action research process. These findings are presented as a new practice theory of working with nature as co-teacher (see Fig. 2). In this step we organized our earlier findings which were (1) the supportive aspects of nature, (2) the supportive aspects in relation to the outcomes of EC language education, and (3) the professional changes the teachers made, into new categories: student initiative, teacher initiative and nature initiative.

These three categories emerged from the important shift the teachers made, from a mostly teacher-led language learning environment to a process of the collaboration between initiatives of the students, the teacher and the nature-based place. Whereas the teachers in traditional EC language education used to focus on the dyadic nature of the interactions between themselves and the students, with a focus on their own input, this new 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.

Child Initiative

Child initiative (Fig. 2) in nature-based places is characterized by exploration of the place, guided by their curiosity towards the life-forms and phenomena they encountered. Students used their language skills as a tool to discover new concepts. The nature-based place afforded diversification of play categories; students engaged in role play, construction play, besides explorative play. While exploring the nature-based place, students asked authentic questions and discussed their embodied actions. During diverse play actions, students negotiated the meaning of the environment in their play activities, talked to themselves to guide their own actions and were thinking aloud. Added to this, while playing in the nature-based place, group composition was more diverse which enriched the conversational patterns.

'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

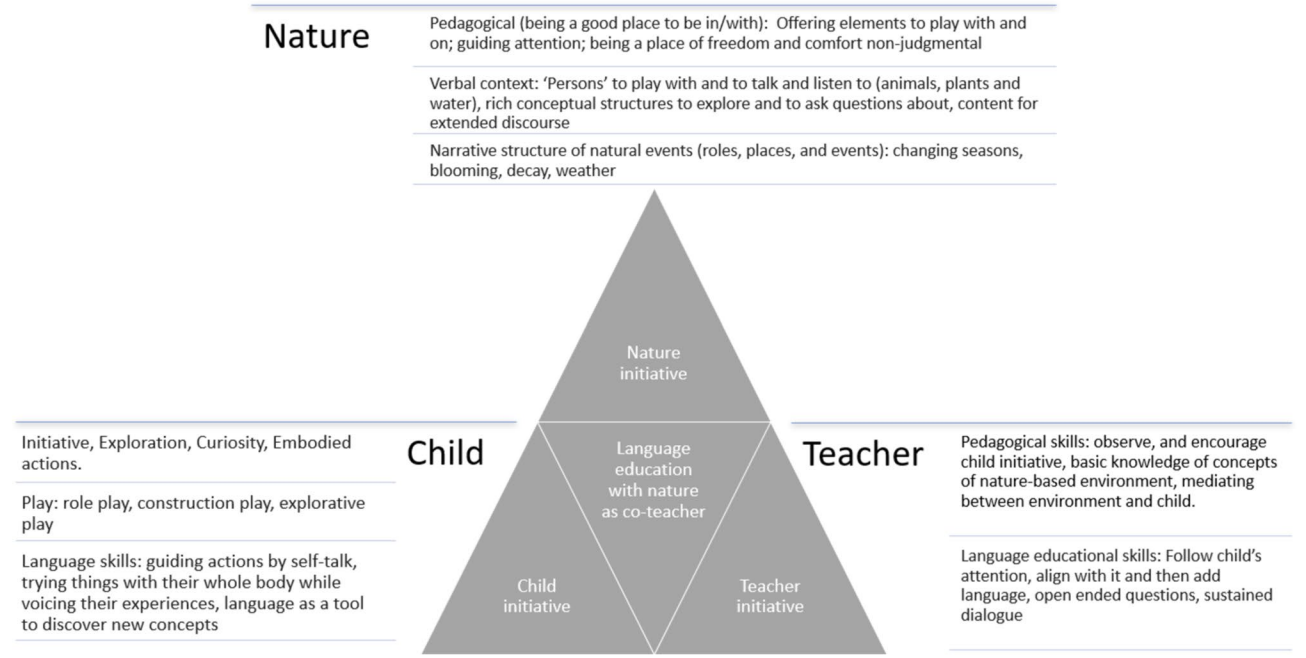

Fig. 2 Language education with nature as co-teacher

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)

Teacher Initiative

Teacher initiative was characterized by pedagogical as well as language educational skills (Fig. 2). To allow for child initiative, teacher's own initiative was attentive, following the student's curiosity towards the phenomena of nature-based places and encourage exploration of this environment. Therefore, they balanced between their own plans and activities and the activities that came up out of the student's interaction 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. 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 rushing 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. They found themselves interacting with both the student and the nature-based place.

To utilize these moments, teachers created specific knowledge about the process of concept building from embodied interactions with the physical word, instead of learning language from (only) verbal interactions. To enhance these coincidental conversations the teacher learned to use interactional language skills, to make room for the students' thoughts and words. 'I need put myself between brackets' a teacher 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 in the interaction of the students with nature, 'like you do with your co-teacher'. Providing 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 the teacher supported them to give words to these experiences. At the same time, they learned to go back and forth a few times in sustained dialogues about new concepts. They learned to trust the rich, conceptual (science) structures that nature afforded.

Nature Initiative

Nature-based places had their own initiative in language education (Fig. 2). Teachers discovered that nature's

initiative looked somewhat like their own initiative, they characterized it in pedagogical terms as well as in language educational terms. The first aspect of nature's initiative was pedagogical: '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)

Second, nature had the power of drawing children's attention, offering rich concepts to play with and experiences of freedom and well-being. 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. Nature afforded a verbal context for communication, where students could meet 'persons' (animals, plants, substances such as sand or waterdrops) and have meaningful interactions with them.

> *'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)*

Finally, nature had its own life. This living character was characterized as narrative; events happened to persons, like in books and stories. Students listened to this narrative character and cooperated in the story.

> *'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)*

Discussion

This study aimed at developing knowledge about EC language education in nature-based places. We explored the possible supportive aspects of nature-based places for teaching language in ECE. Furthermore, we investigated how including nature-based places in EC language education could contribute to the desired outcomes of language education. During this research process EC 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. Recently, the focus of good language education has been more on the quality of the language input (both the linguistic as well as the conceptual quality), and the quality of the teacher child language interactions, as a reaction to the focus on the quantity of the language input, following the Hart and Risley study (Hart & Risley, 1995). However, Rowe and Snow (2019) 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. Moreover, they experienced how the nature-based place interacted with the students in a pedagogical and linguistic way, resulting in conversations on rich concepts, between students, and between student and teacher. Teachers and students 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 suggested an innovative approach to language education, necessitating a transformation in both language education methodologies and outdoor play practices. This theory of practice is characterized by the recognition of three active participants. The first participant is the student; when teaching language in a nature-based place, teachers (re)discovered how the students have an active role 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"(Dewey, 1916). Also in play, children's leading activity during early childhood education, 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).

Although ECE teachers are aware of the importance of their own role in creating rich language learning environments, the new practice theory showed a transformation of their role in the dynamics of language education practice. 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 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 the teachers to offload EC teacher responsibilities to the physical environment. They made room for the interaction between nature and student. For example, consider the students who were searching for snails, picking them up, and allowing them to crawl on their hands while actively articulating their experiences. At the same time, it required learning or reinforcing verbal interaction skills, such as 'follow the student's attention, align with it and then add language', asking open ended questions, and sustaining the dialogue when talking about the questions. In the example of the snails, they learned to follow the attention of the student, instead of immediately starting their own conversation on the housing of snails. In this conversation the students discovered that the snails carried houses on their backs, but also lived under the ground, which was a 'second house' according to the students, leading to the question if the house on the back was better referred to as 'the sleeping room'. They improved their own interactional skills, and learned to lean on the interactional, conceptual and narrative quality of the nature-based place.

The acknowledgment of the agency of nature as the third active participant in the new language education theory was the most innovative. 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. First, 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'. Second, the linguistic function of nature was discovered: the verbal quality and the rich conceptual quality, as well as the narrative quality. In our snail example the teachers discovered the narrative quality by focusing on the story elements of that moment: nature afforded persons (snails) a place (the underground) and an event (the snails coming out of the ground), which supported the students to telling stories on the snail.

In addition, during this transformation the teachers discovered their students' relationship as well as their own relationship with the non-human world (Prins 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; Warden, 2019).

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. The shared production of a new theory of language education was a process of fifty five professionals across five different teams and across five different educational contexts, a process with several strategies to guarantee the validity and the reliability of the study:, (1) prolonged mutual engagement: researchers committed themselves to be part of a school team's CoP for at least 1 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. This suggests that this theory of praxis can be extended to ECE practices beyond the participating schools. 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, which is important information for policy makers and curriculum development.

The aim of this study was to explore nature-based places as a rich learning environment for EC language education. The findings of the study suggest the supportive function of nature-based places for EC language education summarized by the quote of one of the participating teachers: 'I experienced working with nature for language education as working with a co-teacher'. 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.

Appendix

See Table 2.

Table 2 Used codes

(step 1) Initial codes	(step 2) Affordances of a rich learning environment for language education	(step 3) Role of nature	(step 4) Interaction patterns Nature-Child-Teacher
Smell or taste fruits and flowers, feel elements of nature, observe insects, observe birds, talk to each other, private talk	Affords embodied learning experiences, which is related to deep word learning,	Sensory rich (feel, smell, see, balance), colors 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	Affords rich concepts, which is related to rich conceptual thinking and reasoning	Change (weather conditions, grow, blooming and decay)	Child initiative: explore nature's affordances, ask questions, negotiate meaning Teacher initiative: sustained dialogue about (nature)concepts
		Laws of nature (gravity, floating and sinking, warming of the sun, shadows)	Nature initiative: concept richness
Tell story/read book, listen to elements of nature, listen to animal sounds	Affords sounds and stories which is related to emergent literacy/ phonics Affords play partners which is related to communication	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: making sounds (animals, wind, rain), tell stories
Feel free, be happy, laugh, concentration, attention, curiosity, diversification of interaction patterns	Affords essential preconditions for learning being able to learn language, which is related to the 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

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Declarations

Conflict of interest The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

Argyris, C., & Schon, D. A. (1992). *Theory in practice: Increasing professional effectiveness*. Wiley.

Cameron-Faulkner, T., Macdonald, R., Serratrice, L., Melville, J., & Gattis, M. (2017). Plant yourself where language blooms: Direct experience of nature changes how parents and children talk about nature. *Youth and Environments, 27*(2), 110–124. https://doi.org/10.7721/chilyoutenvi.27.2.0110

Cameron-Faulkner, T., Melville, J., & Gattis, M. (2018). Responding to nature: Natural environments improve parent-child communication. *Journal of Environmental Psychology, 59*, 9–15. https://doi.org/10.1016/j.jenvp.2018.08.008

Chambers, B., Cheung, A. C. K., & Slavin, R. E. (2016). Literacy and language outcomes of comprehensive and developmental-constructivist approaches to early childhood education: A systematic review. *Educational Research Review, 18*, 88–111. https://doi.org/10.1016/j.edurev.2016.03.003

Dankiw, K. A., Tsiros, M. D., Baldock, K. L., & Kumar, S. (2020). The impacts of unstructured nature play on health in early childhood development: A systematic review. *PLos ONE* https://doi.org/10.1371/journal.pone.0229006

de Haan, A., Elbers, E., Hoofs, H., & Leseman, P. (2013). Targeted versus mixed preschools and kindergartens: Effects of class composition and teacher-managed activities on disadvantaged children's emergent academic skills. *School Effectiveness and School Improvement, 24*(2), 177–194. https://doi.org/10.1080/09243453.2012.749792

Dewey, J. (1916). *Democracy and education: An introduction to the philosophy of education. An introduction to the philosophy of education*. Macmillan Publishing.

Dey, I. (2004). *Qualitative Research Practice*. SAGE Publications Ltd. https://doi.org/10.4135/9781848608191

Driessen, G. (2017). Early childhood education intervention programs in the Netherlands: Still searching for empirical evidence. *Education Sciences, 8*(1), 3. https://doi.org/10.3390/educsci8010003

Engel, S. (2015). *The Hungry Mind : The Origins of Curiosity in Childhood*. Harvard University Press. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=959200&site=ehost-live

Fukkink, R., Jilink, L., & Oostdam, R. (2017). A meta-analysis of the impact of early childhood interventions on the development of children in the Netherlands: An inconvenient truth? *European Early Childhood Education Research Journal, 25*(5), 656–666. https://doi.org/10.1080/1350293X.2017.1356579

Gilkerson, J., Richards, J. A., Warren, S. F., Montgomery, J. K., Greenwood, C. R., Oller, D. K., Hansen, J. H. L., & Paul, T. D. (2017). Mapping the early language environment using all-day recordings and automated analysis. *American Journal of Speech-Language Pathology, 26*(2), 248–265. https://doi.org/10.1044/2016_AJSLP-15-0169

Girolametto, L., Weitzman, E., & Greenberg, J. (2006). Facilitating Language Skills: Inservice Education for Early Childhood Educators and Preschool Teachers. *Infants & Young Children*, *19*(1). https://journals.lww.com/iycjournal/Fulltext/2006/01000/Facilitating_Language_Skills__Inservice_Education.5.aspx

Goldenberg, G., Atkinson, M., Dubiel, J., & Wass, S. (2024). Outdoor learning in urban schools: Effects on 4–5 year old children's noise and physiological stress. *Journal of Environmental Psychology, 97*, 102362. https://doi.org/10.1016/j.jenvp.2024.102362

Golinkoff, R. M., Hoff, E., Rowe, M. L., Tamis-LeMonda, C. S., & Hirsh-Pasek, K. (2019). Language Matters: Denying the Existence of the 30-Million-Word Gap Has Serious Consequences. In *Child Development* (Vol. 90, Issue 3, pp. 985–992). Wiley. https://doi.org/10.1111/cdev.13128

Hart, B., & Risley, T. R. (1995). *Meaningful differences in the everyday experience of young American children.* Paul H Brookes Publishing.

Harwood, D., & Collier, D. R. (2017). The matter of the stick: Storying/(re)storying children's literacies in the forest. *Journal of Early Childhood Literacy, 17*(3), 336–352. https://doi.org/10.1177/1468798417712340

Hirsh-Pasek, K., MichnickGolinkoff, R., Berk, L. E., & Singer, D. (2008). *A Mandate for playful learning in preschool: Presenting the evidence*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195382716.001.0001

Ionescu, T., & Ilie, A. (2018). Language learning in preschool children: An embodied learning account. *Early Child Development and Care, 188*(1), 4–15. https://doi.org/10.1080/03004430.2016.1189419

Justice, L. M. (2004). Creating language-rich preschool classroom environments. *TEACHING Exceptional Children, 37*(2), 36–44. https://doi.org/10.1177/004005990403700205

Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology, 15*(3), 169–182. https://doi.org/10.1016/0272-4944(95)90001-2

Langeloo, A., Lara, M., Deunk, M. I., Klitzing, N. F., & Strijbos, J. W. (2019). A systematic review of teacher-child interactions with multilingual young children. *Review of Educational Research, 89*(4), 536. https://doi.org/10.3102/0034654319855619

Leseman, P., & Veen, A. (2016). *Development of Children in Relation to Quality of Preschool Institutions. Results of the Pre-COOL Cohort Study*. https://kohnstamminstituut.nl/rapport/ontwikkeling-van-kinderen-en-relatie-met-kwaliteit-van-voorschoolse-instellingen-resultaten-uit-het-pre-cool-cohortonderzoek/

Li, L. C., Grimshaw, J. M., Nielsen, C., Judd, M., Coyte, P. C., & Graham, I. D. (2009). Evolution of Wenger's concept of community of practice. *Implementation Science, 4*(1), 1–8. https://doi.org/10.1186/1748-5908-4-11

Lillard, A. S., Lerner, M. D., Hopkins, E. J., Dore, R. A., Smith, E. D., & Palmquist, C. M. (2013). The impact of pretend play on

children's development: A review of the evidence. *Psychological Bulletin, 139*(1), 1–34. https://doi.org/10.1037/a0029321

Neuman, S. B., Newman, E. H., & Dwyer, J. (2011). Educational effects of a vocabulary intervention on preschoolers' word knowledge and conceptual development: A cluster-randomized trial. *Reading Research Quarterly, 46*(3), 249–272.

Norling, M., & Sandberg, A. (2015). Language Learning in Outdoor Environments: Perspectives of preschool staff. *Nordisk Barnehageforskning*, *9*. https://doi.org/10.7577/nbf.749

Peters, E., Maas, J., Schuengel, C., & Hovinga, D. (2021). Making women's shelters more conducive to family life: Professionals' exploration of the benefits of nature. *Children's Geographies, 19*(4), 475–487. https://doi.org/10.1080/14733285.2020.1826405

Pikulski, J. J., & Templeton, S. (2004). *Teaching and developing vocabulary: Key to long-term reading success (current research in reading/language arts)*. 4.

Platteel, T., Hulshof, H., Ponte, P., van Driel, J., & Verloop, N. (2010). Forming a collaborative action research partnership. *Educational Action Research, 18*(4), 429–451. https://doi.org/10.1080/09650792.2010.524766

Ponte, P. (2002). How teachers become action researchers and how teacher educators become their facilitators. *Educational Action Research, 10*(3), 399–422. https://doi.org/10.1080/09650790200200193

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. https://doi.org/10.1080/09669760.2022.2144147

Prins, J., van der Wilt, F., van der Veen, C., & Hovinga, D. (2022). Nature play in early childhood education: A systematic review and meta ethnography of qualitative research. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/FPSYG.2022.995164/FULL

Pyrko, I., Dörfler, V., & Eden, C. (2017). Thinking together: What makes communities of practice work? *Human Relations, 70*(4), 389–409. https://doi.org/10.1177/0018726716661040/ASSET/IMAGES/LARGE/10.1177_0018726716661040-FIG1.JPEG

Rowe, M. L., & Snow, C. E. (2020). Analyzing input quality along three dimensions: Interactive, linguistic, and conceptual. *Journal of Child Language, 47*(1), 5–21. https://doi.org/10.1017/S0305000919000655

Ruijters, M. C. P. (2013). Donals Schön en Chris Argyris. Double-loop learning. In *Canon van het Leren* (pp. 197–210). Kluwer. https://research.vu.nl/en/publications/donals-schön-and-chris-argyris-double-loop-learning

Schoonen, R., & Verhallen, M. (2008). The assessment of deep word knowledge in young first and second language learners. *Language Testing, 25*(2), 211–236. https://doi.org/10.1177/0265532207086782

Smith, L. B., & Sheya, A. (2010). Is cognition enough to explain cognitive development? *Topics in Cognitive Science, 2*(4), 725–735. https://doi.org/10.1111/j.1756-8765.2010.01091.x

Snow, C. E. (2017). The role of vocabulary versus knowledge in children's language learning: A fifty-year perspective / El papel del vocabulario frente al conocimiento en el aprendizaje lingüístico de los niños: Una perspectiva de cincuenta años. *Infancia y Aprendizaje, 40*(1), 1–18. https://doi.org/10.1080/02103702.2016.1263449

Speldewinde, C., & Campbell, C. (2022). Mathematics learning in the early years through nature play. *International Journal of Early Years Education*. https://doi.org/10.1080/09669760.2022.2122026

Streelasky, J. (2019). A forest-based environment as a site of literacy and meaning making for kindergarten children. *Literacy, 53*(2), 95–101. https://doi.org/10.1111/lit.12155

Strong-Wilson, T., & Ellis, J. (2009). Reggio Emilia's environment as third teacher. *Theory into Practice, 46*(1), 40–47. https://doi.org/10.1080/00405840709336547

Taylor, A., & Giugni, M. (2012). Common worlds: Reconceptualising inclusion in early childhood communities. *Contemporary Issues in Early Childhood, 13*(2), 108–119. https://doi.org/10.2304/ciec.2012.13.2.108

Tomasello, M. (2003). *Constructing a language: A usage-based theory of language acquisition*. Harvard University Press.

Tomasello, M. (2012). *The usage-based theory of language acquisition*. Cambridge University Press. https://doi.org/10.1017/cbo9780511576164.005

Ulrich, R. S. (1983). Aesthetic and Affective Response to Natural Environment. In *Behavior and the Natural Environment* (pp. 85–125). Springer. https://doi.org/10.1007/978-1-4613-3539-9_4

van der Veen, C., de Mey, L., van Kruistum, C., & van Oers, B. (2017). The effect of productive classroom talk and metacommunication on young children's oral communicative competence and subject matter knowledge: An intervention study in early childhood education. *Learning and Instruction, 48*, 14–22. https://doi.org/10.1016/J.LEARNINSTRUC.2016.06.001

Van Oers, B. (2007). Helping young children to become literate: The relevance of narrative competence for developmental education. *European Early Childhood Education Research Journal, 15*(3), 299–312. https://doi.org/10.1080/13502930701679718

Warden, C. (2019). Nature pedagogy: Education for sustainability. *Childhood Education, 95*(6), 6–13. https://doi.org/10.1080/00094056.2019.1689050

Weinstein, N., Balmford, A., Dehaan, C. R., Gladwell, V., Bradbury, R. B., & Amano, T. (2015). Seeing community for the trees: The links among contact with natural environments, community cohesion, and crime. *BioScience, 65*(12), 1141. https://doi.org/10.1093/biosci/biv151

Westby, C. (2017). Depth of vocabulary knowledge in preschool children. *Word of Mouth, 28*(3), 8–13. https://doi.org/10.1177/1048395016683948b

Wilson, M. (2002). Six views of embodied cognition. *Psychometric Bulletin & Review*, *9*(4), 625–636.