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Outdoors as an arena for science learning and physical education in kindergarten

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ABSTRACT

The aim of this study is to provide more knowledge on how outdoor time in Norwegian kindergartens is used as a resource for educational activities regarding science education and physical education. Through a questionnaire and a focus group interview, the study investigated early childhood teachers' perceptions of their work with these subjects and included twelve teachers representing nine kindergartens. According to the teachers, they work more often with these subjects by following up spontaneous situations than through planned activities. They emphasize different science themes and movement experiences depending on the environment they are in and highlight nature as an environment with many opportunities for spontaneous activities. A matter of concern is that one-fourth of the teachers reported that they work only occasionally with these subjects. In addition, the teachers seem to regard themselves less knowledgeable and less prepared to work with science education than physical education.

KEYWORDS

Early childhood teacher; outdoor play and learning; science education; physical education; kindergarten

Introduction

The outdoor environment provides for a variety of unique play and learning opportunities and a growing body of research suggests that play and activities in natural environments are beneficial for children's development and learning in many areas (Waller et al. 2017). Several studies show positive effects of nature contact on various dimensions of children's health and well-being (Chawla 2015; Gill 2014; Maller 2009; Wolsko and Lindberg 2013), cognition (Burdette and Whitaker 2005; Wells 2000), attention skills (Mårtensson et al. 2009; Ulset et al. 2017), motor development (Fjørtoft 2001, 2004) as well as resilience and social behavior (Corraliza, Collado, and Bethelmy 2012; Dowdell, Gray, and Malone 2011; Flouri, Midouhas, and Joshi 2014).

Play and learning in the outdoor environment are associated with changing conditions and unpredictability, as well as an abundance of available space and possibilities for open-ended activities (Stephenson 2002). In early age, movement is children's primary method of action, expression and learning (Trevlas, Matsouka, and Zachopoulou

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2003). Environmental complexity and diversity in nature provide a variety of opportunities for children to become familiar with the natural world through direct sensory experiences (Beery and Jørgensen 2018), various opportunities for adventurous play and exploration (Gurholt and Sanderud 2016), and opportunities to obtain experiences with risk assessment and risk coping (Sandseter 2009, 2012). Furthermore, Nilsen (2008) suggests that children's self-worth and independence are strengthened by learning how to manage the environment and nature where they play and explore. Giving children the possibility to experience nature may also encourage their appreciation of nature (Chawla 2007; Chawla and Rivkin 2014). Several researchers consider children's play in natural environments as an essential element in early childhood (EC) sustainability education, since it provides children with opportunities to build personal and meaningful relationships with nature and to strengthen their environmental consciousness (Barratt, Barratt-Hacking, and Black 2014; Chawla and Rivkin 2014; Skarstein and Skarstein 2020). Beery and Jørgensen (2018) also argue for the importance of childhood nature experiences as a point of departure for the development of ecological ideas and embodied environmental understanding.

Outdoor play as a common objective of science education and physical education in Norwegian kindergartens

Outdoor play and activities have traditionally been a common part of daily life for kindergartens in Norway, and knowledge about the local natural and cultural environment is seen as important in preserving cultural heritage (Lysklett 2017). Accordingly, outdoor play has a significant place in the Norwegian Framework Plan for kindergartens, and active use of local neighborhoods is seen as an important supplement to kindergarten's premises (Norwegian Directorate for Education and Training 2017). In the Framework Plan, science education and physical education are featured under the learning areas 'Nature, environment and technology' and 'Body, movement and health', and the common objective of these subjects is linked to outdoor activities. The Framework Plan states that

Kindergartens shall enable the children to appreciate nature and have outdoor experiences that teach them to move around and spend time in the outdoors during the different seasons. Kindergartens shall enable the children to enjoy a variety of outdoor experiences and discover nature as an arena for play and learning. (Norwegian Directorate for Education and Training 2017)

Play and exploration in natural environments are seen in the Framework Plan as essential for learning to appreciate and understand nature and natural phenomena, as well as for giving children varied, sensory rich and challenging movement experiences. In Norwegian EC teacher education, science education and physical education are integrated into one study entity called 'Nature, health and movement' (Universities Norway 2018).

Children in Norwegian kindergartens spend a fair amount of time outdoors throughout the year. In their study of 117 kindergartens, Moser and Martinsen (2010) found that the children played outside on average 70% of the time during the summer and 31% during the winter. In another study, with over 400 EC teachers as participants, Kaarby and Tandberg (2017) found that most of the children under the age of three were outdoors daily for more than 90 min in the summer and more than 60 min in the winter.

It is also noteworthy that 5–10% of Norwegian kindergartens are defined as nature kindergartens (Lysklett 2017). These kindergartens use nature as a pedagogical fundament for activity, and the children spend most of the day outdoors in natural environments.

Although the children in Norwegian kindergartens are a considerable time outdoors daily, several researchers have called for more critical discussion on the pedagogical content of the time spent outside and question whether simply being outdoors in itself is sufficient to meet the objectives in the Framework Plan concerning outdoor play and learning (Kaarby and Tandberg 2017; Moser and Martinsen 2010). Based on their practical experience, Moser and Martinsen (2010) assume that most of the outdoor time in general is spent on free play on the playground, whereas teacher-led planned activities are conducted indoors. Lysklett (2017), however, discusses how adults in nature kindergartens purposefully try to give children much freedom when spending time in nature and how the role of adults is to support children's spontaneous motivation, excitement and questioning.

Aim of the study

There are few studies on the content of the outdoor time in Norwegian kindergartens, and there is a need for more knowledge on how the outdoor time is used as a resource for purposeful educational activities. This knowledge is important not only for research, but also highly relevant for EC policy and practice. Our study aimed to provide more insight into this topic by taking a closer look at how kindergartens work with science education and physical education, which are subjects closely linked to outdoor activities in the Framework Plan. More precisely, this study investigated EC teachers' perceptions of how they work with these subjects with a focus on outdoor play and learning.

Our research questions were as follows:

- (1) How often and through which type of activities do EC teachers work with science education and physical education?
- (2) Are there differences in how EC teachers work with these subjects indoors, in the kindergarten outdoor grounds and on nature excursions outside the kindergarten premises?
- (3) What do EC teachers find challenging when working with these subjects?

Material & methods

Study design

The study design was inspired by mixed methods research (Creswell and Guetterman 2020; Schoonenboom and Johnson 2017) and used a combination of qualitative and quantitative research components. This approach was chosen for the purpose of mutually enhancing and enriching the different methods used, i.e. for the purpose of complementarity between the qualitative and quantitative results (Schoonenboom and Johnson 2017). The quantitative data were collected through a questionnaire, and the qualitative data were collected through a focus group interview. After separate data analyses, the quantitative and qualitative results were integrated and discussed together.

Participants and sampling procedures

In total, twelve EC teachers from nine different kindergartens participated in this study. They represented all kindergartens within a small municipality in a rural area in south-western Norway. There were one to two participants from each kindergarten, and in the cases of two participants from the same kindergarten, the teachers worked with different groups of children. Nine of the participants were trained EC teachers with either a three-year university or university college level of education, whereas three of the participants had a lower degree of education in childcare. All the participants worked mainly with children of ages three to six. One of the kindergartens was a nature kindergarten, which is in line with the frequency of nature kindergartens in Norway (Lysklett 2017).

The data sampling was conducted in connection to a meeting arranged by the municipality. The meeting was a part of the municipality's work in enhancing the quality of kindergartens, and each of the kindergartens in the municipality was asked to participate with at least two teachers. Before the meeting started, the teachers were informed of the current study, and the those working with children of ages three to six years were asked if they wanted to participate. All the relevant teachers present agreed. The teachers first answered an anonymous questionnaire and then immediately afterwards participated in a focus group interview. One of the informants participated only by filling the questionnaire. However, there were still representatives of all of the kindergartens in the interview part of the study.

Participation in the study was voluntary and all the participants gave their written informed consent, which they could withdraw at any stage or the study. During the interview, no records were made about which participant was talking at any given time. The audio recordings were accessible to the research team only and were deleted after the transcripts were checked for accuracy of the transcription. The study followed the regulations of Norwegian Centre for Research Data (NSD) with regard to personal data protection as well as the EU General Data Protection Regulation (GDPR).

It is important to note that the sample size of this study is too small for generalization. The results provide a representation of kindergartens in one small municipality in Norway. However, small municipalities are typical for Norway. Only 25 of the country's 356 municipalities have more than 40 000 inhabitants and approximately half of Norway's population live in municipalities smaller than this (Statistics Norway 2020).

In addition, since the study is based on the teachers' own statements and self-evaluation, there is a risk of the teachers embellishing the quality of their work. The anonymity of the questionnaire might have reduced such bias, and our impression during the focus group interview was that the teachers seemed very willing to discuss the challenges in their work, even when it came to their own shortcomings. Nevertheless, when looking at the results, this limitation has to be kept in mind.

Questionnaire

The questionnaire had three subsections, which included 11 questions, as follows:

- (1) The first section, with questions Q1–Q3, investigated the amount of time the children spend outdoors.

- (2) The second section, with questions Q4–Q9, investigated how often and through which type of activities the teachers work with science education and physical education (PE) and what challenges they experience in connection to working with the subjects.
- (3) The third section with questions, Q10–Q11, investigated how often and in which environments teachers work in an interdisciplinary manner in regard to science and PE.

All the questions were multiple-choice questions except Q3, in which the teachers were asked to give a time estimate. Questions Q6–Q9 and Q11 were matrix questions, i.e. the same set of response options was used for asking multiple questions. In questions Q7, Q8 and Q9, the teachers were also given the possibility to add answer options of their own if they felt that the options given were not comprehensive enough.

In questions regarding how and how often the teachers work with the subjects, it was specified that the question referenced purposeful educational activity, excluding activities that occur on the children's own initiatives without any involvement from the teachers. The specific science themes and movement experiences given as options for answers in questions Q7 and Q8 were chosen based on guidelines given in the Framework Plan (Norwegian Directorate for Education and Training 2017; Norwegian Ministry of Education and Research 2012) and the recommendations of the Norwegian Directorate of Health for the daily physical activity for children (Norwegian Directorate of Health 2019).

In order to assure the validity of the questionnaire, three independent reviewers, all working with educational research, read and commented on the questionnaire before data collection, and minor changes were made following their comments.

Focus group interview

The focus group interview lasted for approximately one hour and was audiotaped. Eleven teachers participated in the interview. The interview was conducted as an informal group discussion (Wilkinson 2008), and the researchers acted as moderators in the interview, introducing the topics for discussion, facilitating the interchange and encouraging all the participants to actively contribute to the conversation. The teachers were encouraged to discuss and elaborate on the topics in the questionnaire (type and organization of activities, physical environment, challenges) and to share examples from their own practices in science education and PE. The majority of the teachers participated actively in the discussion by sharing their opinions and giving practical examples as well as reflecting on each other's comments and thoughts. In contrast to the closed-ended questions in the questionnaire, the focus group interview challenged the participants to justify their opinions and express their experiences with their own words. Accordingly, shades and precisions appeared in their statements.

Analyses

The answers to the multiple-choice questions in the questionnaire were encoded in a spreadsheet, and the frequencies of different answers were calculated. The focus group interview recording was transcribed orthographically. The transcript was first read several times by both researchers to obtain a sense of the whole, and then analysed using inductive content analysis (Elo and Kyngäs 2008; Wilkinson 2008). The analysis included open

coding, the creation of categories and abstraction. Both researchers first coded the transcript independently using the software NVivo (QSR International Pty Ltd 2018), trying to describe all aspects of the content, and then suggested a set of categories that could be useful when attempting to describe the teachers' practices and views. The two sets of proposed categories were then discussed and negotiated by the researchers and reduced to a single set. The process involved numerous stages of transcript review and discussions between the researchers before a final set of main categories and sub-categories was established. Quotations from the transcript were selected as descriptive examples for each category. The quotations are translations from the Norwegian language.

Results

Time spent outdoors and the frequency of nature excursions

Eleven of the twelve teachers answered in the questionnaire that the children spend time outdoors in the kindergarten's grounds for more than two hours each day (Table 1). In addition to spending time outdoors in the kindergarten's grounds, two teachers reported that they make nature excursions outside the kindergarten premises daily, half of the teachers reported making nature excursions more than once a week, and one-fourth of the teachers make excursions once a week (Table 1). The nature excursions have a duration ranging from two to four hours (Table 1).

Science education and physical education in general

Questionnaire

When looking at how often the teachers work with science and PE as separate subjects (Q4 and Q5), the results show that among the surveyed teachers, it is more common to work with PE than science on a daily basis (Table 2). Most of the teachers (67%) work with science weekly. One-fourth of the teachers reported that they work with science less than weekly, and one-fourth reported that they work with PE less than weekly. Working in an interdisciplinary manner with science and PE (Q10) is less common than working with the subjects separately.

Question Q6 investigated how often teachers work with science or PE either by following up spontaneous situations, through planned activities or through long-term projects. Nearly all the teachers (92%) reported that they often work with both science and PE by following up spontaneous situations (Table 3). Most of the teachers reported working only occasionally with planned science activities (83%), planned PE activities (67%)

Table 1. Number of responses for each category regarding time spent at playground daily and the frequency and duration of nature excursions.

| | | | | |
|---------------------------------|-----------------------|-------------|-----------------------|----------|
| Time spent at playground daily: | <60 min | 60–90 min | 90–120 min | >120 min |
| | 0 | 0 | 1 | 11 |
| Frequency of nature excursions: | Less than once a week | Once a week | More than once a week | Daily |
| | 1 | 3 | 6 | 2 |
| Duration of nature excursions: | 1–2 h | 2–3 h | 3–4 h | 4–5h |
| | 0 | 5 | 5 | 2 |

Table 2. Number of responses for each category regarding the frequency of EC teachers' work with science education and physical education.

| | Never | Occasionally | Weekly | Daily |
|--------------------|-------|--------------|--------|-------|
| Science education | 0 | 3 | 8 | 1 |
| Physical education | 0 | 3 | 5 | 4 |
| Interdisciplinary | 0 | 6 | 6 | 0 |

and long-term projects with a focus on science or PE (75%). Working with science projects is more common than working with projects related to PE.

Focus group interview

In the analysis of the focus group interview, three main categories were established to describe the teachers' views on their work with science and PE (Table 4). The first main category describes how the teachers work with science and PE in relation to the organization of activities. In the interview, the teachers talked about three types of activities: regularly occurring activities, activities in relation to the follow-up of spontaneous situations and long-term projects.

The regularly occurring activities are planned activities that take place at regular intervals and often at a certain time of the day. Such activities can occur both indoors and outdoors and often have a focus on either science or PE. These are activities such as having gatherings with movement-based songs or making science experiments. As exemplified by the following quotes:

Once a week, we get together and sing movement songs.

Once a week we do science experiments ... We carry these out inside the kindergarten in suitable rooms, or outside in the kindergarten.

Many activities take place unplanned when the teachers follow up spontaneous situations. All mentions of such activities in the interview were connected to being outdoors. These activities often focus on either science or PE, but the distinction is less clear. In the interview, many of the teachers seemed to be concerned about following the children's interests and using them in pedagogical situations.

Last time we were out on a trip, all the ponds on the way had frozen. We then started to talk about if it is possible to walk on the ice or not? We had to check this out! So, we figured that we could throw a big stone in the pond first and if the ice cracked, we should not walk on it. So, we got to explore a bit.

One day when it was blowing heavily, the children got to make kites of plastic bags and rope, and then we were out all day. We had some reels that they could wind up the rope on, and it was exciting to get to hold the rope. These are the kind of more spontaneous things we do.

Table 3. Number of responses for each category regarding organisation of science and physical education activities.

| | Science education | | | Physical education | | |
|-------------------------------------|-------------------|-----------|-------|--------------------|-----------|-------|
| | Never | Sometimes | Often | Never | Sometimes | Often |
| Following up spontaneous situations | 0 | 1 | 11 | 0 | 1 | 11 |
| Planned activities | 0 | 10 | 2 | 0 | 8 | 4 |
| Long-term projects | 0 | 9 | 3 | 2 | 9 | 1 |

Table 4. Categories established in the analysis of the focus group interview.

| Main categories | Subcategories |
|-------------------------------------|---|
| 1. Organization of activities | Regularly occurring activities Following up spontaneous situations Long-term projects |
| 2. Opportunities provided by nature | Space Diverse environment Changing environment Direct experiences |
| 3. Challenges | Time Teacher's own limitations Other staff |

Many teachers talked eagerly about long-term projects they worked with. Such projects often have a theme related to science or PE but include activities related to several subjects and can last for several months. The project themes are often decided together with the children. These projects have many different indoor and outdoor activities and many involve visits to different places within the local community. Examples of project topics the teachers worked or had worked with are *life on a farm*, *the human body*, *trees*, *water*, *the local environment* and *outdoor life*.

We had trees as a theme. The entire kindergarten had the same theme, and different activities arose from that. The older children made paper, they had a printing house, and they sorted garbage. They were in the woods and found their own tree and followed its development.

We asked the children what they wanted to start a project on, and they chose the human body ... We are going to explore both the external and internal parts of the body, so we expect this project to continue for a long time.

Science education and physical education in different environments

Questionnaire

Question Q7 investigated how often the teachers work with different science topics either indoors, in the kindergarten outdoor grounds or on nature excursions. Question Q8 looked at how often they focus on providing children with specific movement experiences in the three environments, and question Q11 explored how often they work in an interdisciplinary manner with science and PE in these environments.

The results reveal that there are differences in what the teachers focus on in the different environments (Table 5). Outdoors, there is more emphasis on plants and animals, as well as on running, climbing, balancing, rough and tumble play, and ball activities. Indoors there is more focus on digital technology, songs with movements and collaborative movement games.

There are also some differences when comparing the two outdoor environments (Table 5). For example, there is more emphasis on plants and balance activities on nature excursions, whereas activities such as running and ball activities are more focused on in the kindergarten outdoor grounds. Working in an interdisciplinary manner is clearly more

Table 5. Number of responses for each category regarding EC teachers' emphasis on different science topics, specific movement experiences and interdisciplinary work in different environments.

| | Indoors | | | Kindergarten outdoor grounds | | | Nature excursions | | |
|--|---------|------------|-------|------------------------------|------------|-------|-------------------|------------|-------|
| | Never | Some-times | Often | Never | Some-times | Often | Never | Some-times | Often |
| | | | | | | | | | |
| Science topics: | | | | | | | | | |
| Plants, including trees | 1 | 11 | 0 | 0 | 8 | 4 | 0 | 4 | 8 |
| Animals, including insects and birds | 1 | 10 | 1 | 0 | 3 | 9 | 0 | 2 | 10 |
| Experiments with water | 2 | 8 | 2 | 1 | 9 | 2 | 2 | 8 | 2 |
| Experiments with air, sound or light | 5 | 7 | 0 | 5 | 6 | 0 | 6 | 6 | 0 |
| Digital technology | 2 | 6 | 4 | 3 | 8 | 1 | 8 | 3 | 1 |
| Sustainable development | 3 | 5 | 2 | 3 | 5 | 2 | 3 | 4 | 3 |
| Seasons or weather | 0 | 1 | 11 | 0 | 3 | 9 | 0 | 2 | 10 |
| Movement experiences: | | | | | | | | | |
| Running | 5 | 3 | 2 | 0 | 1 | 9 | 0 | 3 | 7 |
| Climbing | 6 | 3 | 2 | 1 | 1 | 9 | 0 | 1 | 10 |
| Ball activities: throwing, kicking | 3 | 6 | 1 | 0 | 7 | 4 | 2 | 8 | 1 |
| Balance activities | 4 | 4 | 2 | 0 | 6 | 5 | 0 | 3 | 8 |
| Rough and tumble play | 8 | 1 | 1 | 3 | 5 | 2 | 4 | 4 | 2 |
| Songs with movements | 0 | 1 | 10 | 1 | 5 | 5 | 1 | 7 | 3 |
| Collaborative movement games with rules | 0 | 3 | 8 | 1 | 4 | 6 | 0 | 6 | 5 |
| Working in an interdisciplinary manner: | 2 | 7 | 2 | 0 | 8 | 3 | 0 | 5 | 7 |

common when on nature excursions than when being either indoors or outdoors on the kindergarten premises.

Focus group interview

The second main category established in the analyses of the interview describes the opportunities the teachers see in working with science or PE in nature (Table 4). The teachers discussed how being in nature provides many spontaneous opportunities for diverse physical activities, such as climbing, and opportunities for children to explore and wonder. They expressed appreciation for the opportunities that nature provides for direct experiences and variation through its changing conditions, as well as the opportunities provided by the abundance of available space.

In nature, you have plenty of space. The children are very curious about why things are the way they are, and changes happen all the time. This is unlike indoors, where everything is always the same.

During nature excursions, you are surrounded by nature all the time, and you get to use your body a lot.

According to the teachers, these qualities make nature well suited for working in an interdisciplinary manner.

Challenges in working with science education and physical education

Questionnaire

The teachers seemed to find working with science more challenging than working with PE (Table 6). More than half of the teachers (58%) regarded the lack of time as a challenge in science education, whereas only one-third of the teachers reported that the lack of time is a challenge in their work with PE. In addition, almost half of the teachers

(42%) reported the lack of knowledge and lack of equipment as challenges in science education, and one-third of the teachers reported that a lack of interest among the staff is a challenge in their work with science.

Focus group interview

The third main category established in the analyses of the interview describes how the teachers described the challenges they experienced in working with science and PE (Table 4). In the interview, they mainly focused on discussing challenges in general, rather than talking about the subjects separately. The teachers considered time as a challenge with regard to meeting all the goals in the curriculum. They wished they had more time for planning and time to get better acquainted with new things, to acquire more knowledge and become confident about the things they plan to work with. They keenly discussed their own limitations with regard to having enough knowledge to go deeper into specific themes and acknowledged that they could have more awareness and focus in regard to working with science and PE in everyday situations.

You notice that you do a ten times better job if you are confident in what you are doing. I notice that I like best to work with things I master. Then, I also do a better job with the children. So, getting new knowledge helps a lot. I notice that I then think in a completely different way.

There is something about being able to use the correct terms. Also in relation to nature. That that is a birch or a maple, and that we as adults must be able to say the correct things to the children. This is where I think the shortcoming is.

Involving the entire staff was also regarded as a challenge. The teachers discussed how it is important that all the adults participate in planning the activities, since this gives them the feeling of ownership.

Everyone should be able to feel that they contribute; that it is not just me who comes up with all the ideas.

Discussion

Our results show that playing outside is part of the everyday routine for children in all of the kindergarten groups studied. The children seem to spend at least a quarter of the day on the outdoor grounds of the kindergarten. In addition to this, most of the kindergarten groups make nature excursions outside the kindergarten's premises more than once a week. This is in line with previous research showing that children in Norwegian

Table 6. Number of responses for each category regarding challenges in working with science education and physical education.

| Challenge | Science education | Physical education |
|----------------------------------|-------------------|--------------------|
| Lack of knowledge | 5 | 2 |
| Lack of time | 7 | 4 |
| Lack of equipment | 5 | 0 |
| Lack of suitable areas | 1 | 0 |
| Lack of interest among staff | 4 | 2 |
| Lack of interest among children | 0 | 0 |
| Lack of priority from management | 1 | 0 |

kindergartens spend a considerable amount of time outdoors (Kaarby and Tandberg 2017; Moser and Martinsen 2010) and underscores the need for more knowledge on how the outdoor time is used as a resource for educational activities.

In our results, it is evident that the teachers considered the outdoor environment as an arena for pedagogical work with science and PE and not merely as an arena for free play. They seem to purposefully focus on different activities depending on the environment they are in and their choices seem to be based on the opportunities the different environments can offer. They specifically emphasized nature as an environment that offers many opportunities for spontaneous activities and for working in an interdisciplinary manner with science and PE. Similar to our study, Sageidet's (2016) study showed that Norwegian EC teachers place more focus on certain science themes, such as plants and animals, while being outdoors. However, her study did not differentiate between the outdoor time within and outside the kindergarten premises, and one-fourth of the teachers in her study worked in nature kindergartens.

Science and PE are subjects that most of the surveyed teachers reported working with at least weekly, although it seems more common to work daily with PE than with science. On the other hand, long-term science related projects seem more common than projects related to PE. There is noteworthy variation in how often the individual teachers work with science and PE, and a matter of concern is that as many as one-fourth of the teachers reported that they work with these subjects less than once a week. Concerning the guidelines in the Framework Plan and the recommendations from the Norwegian Directorate of Health (2019) regarding children's physical activity, this can be regarded as far from adequate.

The teachers seem to carry out educational activities concerning science and PE mainly through the follow-up of spontaneous situations that occur in the everyday life of kindergartens. Planned activities seem less prioritized. This is in accordance with the results of Kallestad and Ødegaard (2013) who, based on observations from 18 Norwegian kindergartens, found that 80% of all the activities observed were not planned, but were typically a result of the children's own initiatives. They also reported that the kindergartens seemed to place more emphasis on the subject area 'Body, movement and health' than the subject area 'Nature, environment and technology'.

In Norwegian kindergartens, the pedagogical work is based on a tradition of dialogue, curiosity and exploration, and the teachers are expected to follow children's interests and use them in pedagogical situations. Learning is seen as taking place during children's play, as well as in more organized situations, and children's right to participation is seen as important in the planning of educational activities (Norwegian Ministry of Education and Research 2015).

The results of our study appear to reflect this tradition. The teachers gave several examples of valuable learning situations that have arisen from following up spontaneous situations. Nevertheless, one must discuss the possible consequences of the seemingly low priority of planned activities. As Kallestad and Ødegaard (2013) discussed, it is critical to investigate whether the learning quality of unplanned activities is the same as that of planned activities. One might also question whether all the objectives in the framework plan can be met through unplanned activities, since the lack of planning may lead to the prioritization of some themes and activities, while others may not receive enough attention. In addition, several researchers have expressed concern regarding EC teachers'

competence in recognizing and fully facilitating the learning possibilities available outdoors (Gustavsson and Pramling 2014; Kaarby and Tandberg 2017; McClintic and Petty 2015). Several teachers in the present study expressed their lack of knowledge or lack of awareness as a challenge. As one of the teachers stated, 'A lot of spontaneous activity, like climbing, takes place when we are outdoors. On nature excursions, there is a lot of such activity that takes place without us being so focused on it'. The teachers' ability to recognize and support informal learning situations may have a significant impact on the quality of unplanned activities (Gustavsson and Pramling 2014).

Children's experiences and learning outdoors are influenced by the pedagogy of the teachers and the manner in which the teachers and children engage (Mawson 2014; Waters and Bateman 2015). Interactions between adults and children that are characterized by responsive communication, opportunities for joint attention and depth engagement seem to enhance opportunities for learning (Waters and Bateman 2015). According to Bae (2018), both teacher-initiated and child-initiated interactions are important in outdoor learning; teachers have an important role in both following up children's own discoveries and making children aware of things that they do not necessarily discover on their own. Mawson's (2014) study of children's play in nature and their interactions with teachers illustrates how applying a variation of pedagogical strategies ranging from free play to teacher-directed activities may provide children with a greater chance to utilize the affordances of an environment than if only one pedagogical strategy is used.

Simply being outdoors is also no guarantee that children will utilize the versatile movement opportunities provided by the environment. Children's physical activity levels depend on both environmental and individual constraints (Giske, Tjensvoll, and Dyrstad 2010; Storli and Hagen 2010). Some children will to a greater extent than others depend on the teacher facilitating and organizing activities to maximize the potential of the environment to meet their needs for various movement experiences.

An important finding of this study is that the teachers seem to view working with science more challenging than working with PE. This might explain why science learning also has less emphasis in their pedagogy. Nearly half of the teachers regarded the lack of knowledge and lack of equipment as challenges in their work with science education. The teachers, however, expressed an interest in acquiring more knowledge so that they could feel confident delving deeper into specific themes. Recent international studies, reporting on low quantity of science education in kindergartens, have found a positive relationship between EC teachers' science competence and the frequency of their science practice (Oppermann, Hummel, and Anders 2019; Saçkes 2014). The availability of science related instructional materials in kindergartens (Saçkes 2014) and EC teachers' confidence in teaching science (Gerde et al. 2018; Oppermann, Hummel, and Anders 2019) has also been shown to influence the frequency of science education in kindergartens. Moreover, the amount of science training EC teachers receive during their initial teacher education seems to be related to EC teachers' science-specific pedagogical content knowledge and science teaching confidence (Barenthien et al. 2020).

The results of this study have important implications for EC teacher training. It is essential that both initial teacher education programs and professional development courses provide EC teachers with the necessary competences to adequately support children's science learning as well as their physical and motor development. EC teacher

training should also ensure that teachers have sufficient knowledge and skills to facilitate the variety of possibilities that exist in outdoor play and learning.

Conclusion

Our study provides insights into how Norwegian kindergartens work with science education and physical education and contributes to the discussion on the pedagogical content of the time spent outdoors in kindergartens. According to the EC teachers who participated in the study, they mostly work with science and PE by following up spontaneous situations. They purposefully focus on different science themes and movement experiences, depending on the environment they are in, and they particularly appreciate nature as a learning environment. It seems clear that the teachers regard the outdoors as an important arena in their work with these subjects and not merely as an arena for free play. A matter of concern is, however, that there is considerable variation regarding how often the teachers work with these subjects and that the teachers seem to regard themselves less prepared to work with science than with PE. A lack of time was reported as the most common challenge for working with the subjects, in particular having enough time to plan, to acquire enough knowledge and to work with all the goals set forth in the curriculum. Further exploration of the challenges experienced by teachers can contribute to finding solutions regarding how the quantity and quality of science education and physical education may be strengthened in kindergartens.

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