



# Preschool Teachers' Experiences of Using Projected Images and Videos in Attempted Play-responsive Science Teaching

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## Abstract

When preschool teachers attempt to initiate play-responsive science teaching, opportunities arise to develop or challenge the play further, for example, by introducing or focusing on science content. The aim of this article is to generate knowledge about how projected images and videos can be used in attempted play-responsive science teaching and what they can contribute to. Eleven preschool teachers participated in a Continuous Professional Development project about play-responsive teaching and science. Participating preschool teachers' discussions about using projected images or videos in attempted play-responsive science teaching was thematically analysed. Three main themes have been developed: content of the projected image or video, different ways of using projected images or videos, and reasons for using a projected image or video in attempted play-responsive science teaching. Results show that projections could be used as support in play, e.g., when imagining being in another place, like under the surface of the ocean or as a way of introducing science concepts in play. Play-responsive science teaching with support of projected images and videos is found to be a threefold challenge for the preschool teachers, encompassing knowledge about play, science, and digital tools. The important role of preschool teachers in making the projections become a part of play-responsive science teaching is discussed.

**Keywords** Play-responsive science teaching · Digital tools · Early childhood education · Professional development

## Introduction

Play-responsive teaching is based on the preschool teacher and the children engaging in a shared activity that is open to play (Pramling et al., 2019). Preschool teachers can participate or initiate play with the intention to focus on or introduce specific content, such as science. However, in play-responsive teaching, teaching is aimed to take place in response to children in play. Play-responsive teaching is a way of creating opportunities for teaching and play to meet in a practice, where these sometimes are described as dichotomies. Play-responsive teaching is a relatively new way of approaching teaching in preschool, but there is a need for further research regarding how preschool teachers can use this approach in their practice (Pramling et al., 2019). The study presented here is based on preschool

teachers' discussions in a Continuous Professional Development (CPD) project where ways of working with play-responsive teaching and science are developed. Previous studies from this project have shown that some preschool teachers initially emphasise difficulties in participating in play (Lund et al., 2024a). They also highlight opportunities to play with science content (Lund et al., 2024a, b). This article focuses on the use of projected images and videos in attempted play-responsive science teaching.

One way to support preschool teachers and children in a mutual play with science content can be to project images or videos in attempted play-responsive science teaching. Using digital tools in teaching, in this case, projections, creates a demand for preschool teachers to develop digital and pedagogical skills (Lindeman et al., 2021). Hence, opportunities are needed for preschool teachers to discuss and reflect on when, how, and why digital tools should be used. Concepts from a theoretical framework, such as Play Responsive Early Childhood Education and Care (PRECEC), can mediate such discussions (Stavholm et al., 2023). The actual contribution of projected images and videos to an activity

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have been problematised during the project, as exemplified by Emilia's remark in a focus group:

But did you feel that when you had this now, the digital on the wall, did it contribute to anything or what did you feel when you had it? Because it did not feel like there was so much focus for them there. It was more the physical [materials]. Do you think... Did it give anything to the children, their imagination, or is it something that we think that children need? Is it something that we feel will inspire the children or is it just something that is on the wall? (Emilia FG 6:O).

This quote is used to introduce the aim of this article, that is, to generate knowledge about how projected images and videos can be used in attempted play-responsive science teaching and what these projections can contribute to in these attempts. The research question guiding the analysis presented here is:

- In what ways do preschool teachers describe their reasons for using and the contributions of projected images and videos in attempted play-responsive science teaching?

The Swedish curriculum contains different goals to strive towards. It is up to preschool teachers to plan and ensure that teaching takes place in accordance with the goals (Swedish National Agency for Education, 2019). However, teaching could be based on content planned in advance or on something that occurs spontaneously, as children's learning and development are described as taking place all of the time. One of the goals to strive for according to the curriculum is specifically about science, i.e., to create possibilities for children to develop "an understanding of natural sciences, knowledge of plants and animals, and simple chemical processes and physical phenomena" (Swedish National Agency for Education, 2019, p. 15).

## Digital Tools in Preschool Science

Previous research shows that there are multiple ways for preschool teachers to use digital tools in interaction with children such as in play, exploration, inquiry and in creative processes (Undheim, 2022). Walan and Enochsson (2022) have studied various possibilities for integrating digital tools into science teaching in preschool, including how and why these could be used. One way is to seek information together with children. This could be described as a way to support children and preschool teachers as co-learners in an activity (Johnston, 2019). The children and the preschool teacher can then find information together based on the

questions that emerge, instead of having expectations that the preschool teacher should know everything.

Otterborn et al. (2024) highlight that the tablet could be used to connect digital and analogue ways of teaching science. It could, for example, be used for filming, taking pictures, searching for facts or using apps, but also in combination with other digital tools like action cameras and microscopes. To include digital tools in mutual activities creates challenges for preschool teachers to know how digital tools can be used, but also how these can be used in combination with other tools (Walan & Enochsson, 2022). Connecting analogue ways of exploring science might be, for example, using tools and materials, as well as looking, feeling and smelling. Based on this, Otterborn et al. (2024) highlight that digital tools could be used as a way of strengthening and diversifying analogue resources. Nilsen (2018) describes how preschool teachers, in some activities, use tablets and apps to replace previous analogue ways of conducting the activity. This may imply that other limitations of the activity emerge when the focus is directed towards the technical conditions of the hardware and software instead of the aesthetic aspects of the activity (Nilsen, 2018).

The use of different representations in science teaching is often motivated by the fact that it is more likely to engage children's interests and thus create opportunities for learning (Ainsworth, 1999). Furthermore, Ainsworth (1999) describes how multiple representations can contribute to visualising the content and the importance of identifying the function of the chosen representation. Connecting digital tools to a projector is described as creating opportunities for more children to participate and re-experience an activity. The projection can be a way of visualising something that the preschool teacher wants the children to see. This creates opportunities for several children to see at the same time (Walan & Enochsson, 2022). However, there is limited research concerning the contribution of using projections in play and preschool science.

## Play-responsive Science Teaching

The theoretical framework Play-Responsive Early Childhood and Care (PRECEC) is based on empirically studying teaching responsiveness to play (Pramling et al., 2019). In activities with teaching and play, the framework provides conceptual tools for analysing what happens in the interaction between preschool teachers and children, and it can also be used as an approach for preschool teachers when aiming for teaching in response to play, i.e., play-responsive teaching (Pramling, 2022; Stavholm et al., 2023). To create opportunities for play-responsive teaching, preschool teachers need to participate together with children in an activity

open for play, that is, shifting between *as if* and *as is*. This is described as participants in play shift between, for example, talking about a phenomenon as it appears to the participants (*as is*) or embedded in imaginative play (*as if*). As the participants in the activity act based on *as if*, opportunities to learn about the world *as is* may occur. As a more experienced participant, the preschool teacher can be seen to have an important role in creating rich play experiences and introducing resources to promote and broaden the children's play experiences (Pramling et al., 2019). The preschool teacher can initiate these shifts between *as if* and *as is* by changing their voice to take the role of a character or through bodily expressions (Henriksson et al., 2023).

From this perspective, teaching takes place in response between the participants, which means that all participants in the activity (preschool teacher and children) are equally important. However, the preschool teacher has an important role as a more experienced participant (Pramling et al., 2019). The preschool teachers' different ways of influencing the play, verbally or by other actions, are described as *triggering*. (Pramling et al., 2019). Opportunities for *triggering* could be seen when preschool teachers enable space for co-narrators, direct the narrative of the play, or create opportunities for the children to speak and act from the perspective of a character. When engaging in the mutual activity, preschool teachers can also support the children in meta-communicating about the play or challenge them with questions in response to play. Actions of *triggering* can, for example, be to encourage fantasising or explore something unexpected in the play. (Pramling et al., 2019). Further, Wallerstedt et al. (2021) highlight that *triggering* requires responsiveness, which indicates that an action without a response from the children cannot be seen as *triggering*. In line with this, projected images and videos are in this study used as a possible way for the preschool teachers to *trigger* play introducing or focusing on science content.

## Research Design

This study is based on a two-year long Continuous Professional Development project (CPD) about play-responsive teaching and science in preschool. The project took place at one preschool in a smaller municipality in Sweden with eleven preschool teachers who have interest and experience of working with science. The majority of the children and the preschool teachers have Swedish as their first language. The preschool teachers work either in a younger children's group (ages 1–3) or an older children's group (age 3–5). However, they do not continuously work with a specific age group but follow the children from the time they start preschool until they leave to start school. This means that

during the two-year project some of the preschool teachers shifted from working in a younger children's group to an older children's group or vice versa. All preschool teachers at the preschool were involved in the project.

Each semester of the project was organised similarly, starting with an intervention consisting of lectures or reading an article (Pramling & Wallerstedt, 2019). The use of projected images and videos was presented early in the project as a possible way of including digital tools as a way to introduce or illustrate science content in attempted play-responsive teaching. However, the preschool teachers were free to use other digital tools suited to their activity. After each intervention and focus-group discussion, the preschool teachers attempted to initiate play-responsive science teaching. These attempts were video-documented by the preschool teachers, and the preschool teachers brought a selected sequence from the video documentation to the upcoming focus-group discussion. The video documentations were used as stimulated recall to support the preschool teachers in reflecting on and discussing their experiences (cf. Geiger et al., 2016; Reitano & Sim, 2010), and were not analysed per se. There were 14 focus-group discussions (eight of which included stimulated recall). Each focus group lasted approximately one hour and was audio-recorded (for a more detailed description of the research design, see Lund et al., 2024b).

## Analysis Process

This study aims to generate knowledge about how projected images and videos can be used in attempted play-responsive science teaching and what these projections can contribute to in these attempts. Audio recordings of the focus groups have been transcribed verbatim and read through thoroughly in a first step to thematically analyse the generated data (Braun & Clarke, 2022). The process of coding the data was done in several steps using NVivo™. Initially, the focus was directed towards discussions relating to digital tools and how and why these were described to be used in the activity. Initial themes were developed by compiling clusters of codes that seem to share a core idea or concept (Braun & Clarke, 2022). Furthermore, these broad themes were organised and structured and related to *as if*, *as is*, and *triggering* (Pramling et al., 2019), as earlier described, in order to analyse how the projection is described to be used in the activity. The excerpts presented in the results have been translated from Swedish. The preschool teachers' video documentation was an important part of the discussions but is only seen as a basis for stimulated recall and does not form a part of the analysis. However, descriptions of the video documentation are presented in connection to the excerpts below to create an understanding of the

context of preschool teachers' discussions. The process of coding and developing themes was qualitative and reflective where continuous discussions between the authors have taken place in the process of reviewing, refining, defining, and finally naming the themes (Braun & Clarke, 2022). The empirical data that forms the basis for this analysis has also been analysed with a focus on the preschool teachers' initial discussions, and with a focus on the science content (Lund et al., 2024a; 2024b). This means that examples presented here may also occur in earlier studies, but with a different focus.

## Ethical Considerations

Ethical considerations follow the recommendations from the Swedish Research Council (2017). This project is based on the engagement of the preschool teachers who are responsible for creating the video documentation that forms the basis for the discussions. The importance of stopping the recording if a child showed signs of not wanting to participate was discussed. All participants and caretakers were informed about the purpose and methods of this study and approved their participation by signing a consent form. Participating in the study was voluntary, with the right to withdraw at any time. All participants names are changed into pseudonyms.

## Results

The interest in this study is directed towards ways that preschool teachers describe their reasons for using and the contributions of projected images and videos in attempted play-responsive science teaching. The results are presented in three main themes concerning attempted play-responsive science teaching (1) content of the projected image or video, (2) different ways of using projected images or videos, and (3) reasons for using a projected image or video.

### Content of the Projected Image or Video

There is a variety of content of images and videos that the preschool teachers use in their attempted play-responsive science teaching. This theme consists of two subthemes; *As support to imagine being in another place*, and *Exploring science concepts*.

#### As Support to Imagine Being in Another Place

The projected image or video is here described as a representation of a place associated with science content, somewhere the preschool teacher and children can pretend to

be together. This has been shown in examples where the participants pretend to be in places where there are no possibilities to visit in real life, for example, under the surface of the ocean or in a rainforest. In other examples, it is places that the children have shown interest in but where the real environment creates limitations for play, for example, in an anthill. A possible way of using projected video to initiate play in and around an anthill is shown in video documentation and presented further here.

I staged a small hut and projected a film I found on YouTube from an anthill. Then I took out some props, with some wooden blocks and yes then there was some more around too. So that was the environment that we came into (Cecilia, FG 6:Y).

By staging an environment where the projected video was central, attention was drawn to the science content (*as is*). The hut was staged by hanging a white sheet over a table next to a wall, and the projection of the anthill landed on the wall behind the table and on the sheet. This staging was made by the preschool teacher to create a representation of an anthill and to initiate play pretending to go into the anthill (*as if*). By using a video that was filmed in close-up, possibilities for the children to get a feeling of being close to the ants were created. The representation of place, the anthill, was clear as described by the preschool teacher:

When they came into the room, they said "ant" straight away because they saw the ants. And he also said anthill. They would of course not have noticed that if it wasn't for the projected video, then I would have to say it (Cecilia, FG 6:Y).

Even if the digital representation of the place was clear the narrative and the participants' roles in play were not predetermined. Cecilia responded to the interest and curiosity shown by the children to *trigger* play including *as if* and *as is* about ants and the anthill. This can also create opportunities for teaching in response to children's play as described by Cecilia:

I thought I was going to include a little bit about how they live, and then I had the concept of fir needles and that they build their anthill with that. And then what they eat. I mention that they eat green (leaves) and beetles/bugs. But then I did not pay much attention to it (the concepts), but I still used them. So I guess those were the concepts, live and eat (Cecilia, FG 6:Y).

Similarly, to include concepts is to include or take a starting point in a question or a problem to solve. This can be seen in the following example:

My focus was... we have been working with the sea and now it was that we were going to be in the ocean, that is, how can animals live in the ocean and how can people be in the ocean, what do you need to be in the water for a longer period of time? (Jonna, FG 2:O)

In this example, Jonna projected a video from under the surface of the ocean. The participants in the play concluded that they needed diving equipment for play to continue. They pretended to use the equipment in play *as if* they were under the surface, which could be one way of learning about the world *as is*. Within this subtheme, there are also examples of preschool teachers projecting places that the children have previous experiences of as a way of *triggering* play, like images from a field trip to the woods.

### Exploring Science Concepts

This subtheme is about projections that support exploring specific science concepts. The science content are introduced by either preschool teacher or child. In the following examples the concept of light is visualised by a projected image of photons. Both Emilia and Jenny have attempted play-responsive science teaching with this content, but with different groups of children:

We started working with light. So, one day when we sat and talked about it, we talked about what was in the light and we got into photons. The children thought it was really cool with a new word, but it meant that we needed to make it a little more, to make it a little clearer to the children about what light is. We talked about the direction of light, that it moves straight ahead. Then we wanted to dramatise it in some way... we tried to do this with a flashlight, that you are the light that comes through the flashlight (Emilia, FG 4:O).

To *trigger* play where the participants pretended to be photons travelling through a flashlight (represented by a hula hoop), the preschool teacher projected an image of photons on the wall. The children jumped through the hula hoop, pretending to be photons (*as if*). In this way, the projected image can help to visualise the photons (*as is*), but not as part of the play. This was done on by both Jenny and Emilia, but on different occasions:

But the funniest thing was when, because we changed image, we had two different images, because we

thought we could have different ones. Mine came in and said that there are photons on the wall before we had started filming (Jenny, FG 4:O).

This example shows how the image could be seen as a way of directing the children's attention to science content. The statement indicates that the children associate the image with photons as they have prior experiences with the content. Furthermore, it can be said that the image was included in the activity as support for the science concept. It was the basis for the play where the children jumped through a hula hoop *as if* they were photons.

Another example within this subtheme is a play with dinosaur figures that took a new direction when a preschool teacher projected an image of a large dinosaur on the wall in connection with the children's play. The preschool teacher expressed that the image was intended as a way to contribute to the ongoing play with dinosaurs. However, the children initiated an exploration of how shadows are created on the wall and investigated a pattern from the projected image that fell on the hand of a child when they stood between the projector and the wall. The exploration is child-initiated, and the preschool teacher responds to the children's interest by introducing the concept of shadow.

### Different Ways of Using Projected Images or Videos

Based on the preschool teachers' discussion regarding their attempted play-responsive science teaching different ways of using a projected image or video were described and are presented in two subthemes: *As an introduction to play*, and *As a part of the play*. However, sometimes the projection was given little or no attention in the initiated play. The intention described by the preschool teacher could be to stage an environment including the projection, but other material presented were used to *trigger* play. In this way, the image or video ended up as a background and was not used in the attempted play-responsive science teaching.

#### As an Introduction to Play

Within this subtheme, the preschool teachers' discussions show that the projected image or video has been used as an introduction to the activity. This can be seen as a way to *trigger* mutual play by, for example, focusing on science content. In one example, a preschool teacher initiated play by projecting an image of the woods in a room. This is how the preschool teacher described how play was initiated:

So, I was in an environment that was the woods. I had not prepared anything else, but I thought that we go into this environment, and project an image of the

woods and see where they end up and follow that. They got really engaged, and very fun, and very easy to follow./.../So I think I really just went in and said ‘shouldn’t we go exploring in the woods’ or something like that (Sara, FG 9:O).

In this example, the activity was described as being open to take any direction. The children decided, together with the preschool teacher, what they wanted to play and how they wanted to proceed with the play. The preschool teacher directed the content of the play towards science by introducing the environment, a projection showing the woods *as is*. As the narrative of the play was not predetermined, this was set together with the children when pretending to be a shrewmouse (*as if*) as further described by the preschool teacher:

...I actually heard that it was the boy in the patterned sweater who gave me the role of a shrewmouse. I heard it at the beginning, that he said it. I think that was when I just got started, I thought “ok, how can I think, that it is a little scared, little and small, why is it scared...?” like that. Then I probably created it quickly in my head and spun on that (Sara, FG 9:O).

Somehow, I think it is hard to plan to much in advance because, even here, you got the role. If you had planned it beforehand, then you might not have accepted his wishes for a shrewmouse. Because then you had already decided whatever it could be, like a squirrel (Cecilia replies to Sara, FG 9:O).

In this statement, Sara’s description of how one of the children gave her the role of a shrewmouse shows aspects of challenges that arise in a play not planned in advance. The play was created based on the environment they entered and in response to initiatives from a child. Even if they pretend to be a shrewmouse (*as if*), the preschool teacher described having the opportunity to introduce knowledge about the shrewmouse (*as is*). Further, the role of the projected image was discussed as it was used to *trigger* the play:

It was more of an introduction to the play perhaps. But then they let it go (in the play), so it wasn’t needed either. That was why I tried to fix it, to try to get it started but then, just no- ’now I’m missing a lot here, so I’d rather be here’ (Sara, FG 9:O).

During the video-documented activity, the projected image went out as the tablet went into energy-save mode. The fact that the projected image went out is more related to technical aspects, but it also made the preschool teacher reflect on

her role and how the image contributed to the play. When shifting her attention from the play to solving the problems with the projected image, she expresses that she missed what happened in the play. This example further demonstrates how the digital image can be used as an introduction to play or as support for *triggering* play with a focus on specific content but does not necessarily need to remain part of the play.

### As part of the play

In the preschool teachers’ discussions, there were also examples of the digital image or video being used in interaction between the preschool teacher and children and as a part of the play. One example of this is when a preschool teacher describes how a photo taken on a mutual exploration focusing on woodlice in the woods was projected when they later pretended to be woodlice in a play. Another example is described by Camilla, where a video from underneath the surface of the ocean was projected:

We projected the ocean, one of those videos where there are turtles and dolphins and all that. It had been up the day before, and then the same day. Then they (the children) became interested and wondered ‘what is that?’ and stood and watched. Then, ‘Shall we play?’ I wondered. Everyone said ‘yes’ and they came (Camilla, FG 6:O).

To start up the play, the preschool teacher describes how they need to decide on what type of animal they want to be (*as if*). The preschool teacher further describes that she, in the process of deciding roles, asked questions about the different suggestions, what they eat and what they do (*as is*). Camilla recount: “*I picked it up and I asked it ‘what does it eat?’ , and ‘what does it do?’ and ‘how big is it?’ . Yes, it was quite a bit of facts*”. Furthermore, the preschool teacher enlists help from the children to decide on a role for her. The children suggested that she could be an octopus. In that way, the projected video is used as a representation of place, and the children, together with the preschool teacher, create their representation of an octopus by several children standing behind the preschool teacher, as shown in the following excerpt:

‘Yes! But I only have two arms’. Some children stood behind me, so now I had eight arms. ‘Well, I said, you’ll have to count. I didn’t really see what they were doing in the back, but no, there were too many. There were ten arms. It was too many...At last, I had eight arms. And then there were great white sharks and all sorts of things, but ‘oh, they eat octopuses, what

should we do now?’ ‘Then we have to hide!’ So, we should fold up and suddenly I had them all on my back instead. It was a lot of fun (Camilla FG 6:O).

Unlike the example from the previous subtheme, where the projected image was used as an introduction to the play, this play is described as taking place in interaction with the projected video. The video aroused the children’s curiosity and interest, and was used as a way to *trigger* a play, but also as a part of the narrative. The preschool teacher together with the children were below the surface of the ocean where, for example, turtles and dolphins swam by.

### Reasons for Using a Projected Image or Video

Based on the preschool teachers’ discussions regarding the content of the image or video that is projected, and different ways of using the projection in play, various reasons for using digital tools in attempted play-responsive science teaching emerge. These reasons are presented in two sub-themes; *Connecting children’s prior experiences* and *To support participation*.

#### Connecting Children’s Prior Experiences

This subtheme is about preschool teachers using projections to connect to children’s prior experiences. Cecilia describes one way of using digital images to connect a shared experience with play:

And of course, the environment has done a lot to the other times we have filmed. But it is the first time that I felt that the digital image made more of a difference than the other times... Certainly not all the time. And I’m inviting them to it in the beginning as well, so it started off a little bit around it. I think it has to do with the fact that when we were in the woods we took this picture together, one of the pictures. Because we took a picture of where the woodlice lived. So, they recognised the picture. The last time I found a random image that I thought fit (Cecilia, FG 9:O).

In the video-documented activity, the participants play in front of and interacted with a projected picture taken by Cecilia and the children in the woods. The participants shift between playing with woodlice (sewn grey oval-shaped figures without details) and pretending to be woodlice. The play contains both aspects of *as is* (where woodlice live, how they move, and that they like to hide) and *as if* (a child introduces a shark that is friends with the woodlice in the play). Furthermore, there are also other ways to take children’s experiences into account, for example, in a video

documentation presented by Jonna as earlier described. The participants were playing that they were under the surface of the ocean. It becomes clear in the play that they need to figure out a way to be under the surface of the water for a long time. One of the children had previously seen on a television program that they used diving equipment, which then became part of the play. In this way, they did not have any real experiences of diving under the surface, but in play, they could explore this together by pretending.

#### To Support Participation

One aspect of why projected images or videos could be used in play-responsive science teaching is exemplified based by the play initiated by Emilia. The participants pretended to be on an adventure to save the butterflies. A video of butterflies was projected on the wall, and binoculars were available to the children. Emilia reflected on how the projected video supported the children in play:

I think it was the projection that did too, and that everyone got binoculars, that you had the same, not just that we should go on a journey of discovery, but they had some tools to be able to do it as well. It became clear what we were supposed to do as well, especially for those children who think it is a little bit tricky with the play codes, that they got a clear picture of what is expected and what roles you have. So, it has been really useful (Emilia, FG 2:O).

The initiated activity includes aspects of both *as if* (imagining being on an adventure to save the butterflies) and *as is* (using real binoculars to look at the projected video of butterflies). In this excerpt, the preschool teacher describes how the projected video not only is used to *trigger* play with a focus on a place or content but also could be used to support children in play. Other preschool teachers have also described that the children later asked for the projected image to continue their play on their own or together with the preschool teacher. In this way, play-responsive science teaching can give the children new play experiences to develop further.

However, it cannot be seen as self-evident that the projected image or video contributes to support participation. The preschool teachers described using projections in the preschool environment to inspire play, as described here by Sara:

We have projected a little bit in a room. It could be a forest environment, and sometimes animals, to see what happens to the play in that room. Sometimes you can see that there is an excursion, and sometimes it is



more a family-play. Sometimes they just sit and watch (Sara, FG 8:O).

Later in the discussion, Sara returns to this example and elaborates on what she sees happening when they project images or videos in the children's environment without the support of a preschool teacher.

Yes, and at the same time if we look at our room that we have prepared, that we somehow thought that 'ah, this is going to set of forest play' but it has not always been that way. And it is not a room that is as frequently used as. sometimes it is empty, and you are like, oh well. And we have tried to add and project sometimes but jet. So maybe they choose to play in other rooms, but the same play... (Sara, FG 8:O).

In this way, the preschool can have a well-thought-out environment to inspire play, but what happens or does not happen in the environment could be seen as being up to the children. Furthermore, this statement could indicate that even if the preschool teacher has an intention with the projection/environment created in their practice it is not always the case that this inspires play. The digital image or video is not automatically used by the children to play in line with the preschool teachers' intentions. However, after this focus-group discussion, Sara initiated play-responsive science teaching in the environment as earlier described. The projected image was then used as an introduction, to *trigger* play pretending to be in the woods. In that way the projected digital image or video could be seen as support in preschool teachers attempted play-responsive science teaching, but what role the projection gets is based on the interaction between the children and preschool teachers.

## Discussion

In this study, the focus has been on preschool teachers' discussions of how a projected image and video can be used in attempted play-responsive science teaching, and what they can contribute to in these attempts. As an introduction to this discussion we would like to return to Emilia's questions presented in the introduction:

But did you feel that when you had this now, the digital on the wall, did it contribute to anything or what did you feel when you had it? Because it did not feel like there was so much focus for them there. It was more the physical [materials]. Do you think... Did it give anything to the children, their imagination, or is it something that we think that children need? Is it

something that we feel will inspire the children or is it just something that is on the wall? (Emilia FG 6:O).

The preschool teachers' discussions have been organised in themes based on content of image or video that is projected, different ways of using projected images or videos, and reasons for using a projected image or video in attempted play-responsive science teaching. The analysis has shown examples where the projection has added another dimension to the play, thus supporting the participants to imagine being in another place together (*as if*) or as a way to trigger curiosity or visualise science content (*as is*). Their discussions concerning their attempted play-responsive science teaching can furthermore contribute to developing new ways of *triggering* play with or about science content. In the attempts where the projected image or videos are used as an introduction to the play, or used in interaction with the children, the projection can be seen as a pedagogical tool, i.e., as a way to *trigger* play or support the participants in the activity. The projection of an image or video in play creates opportunities for participants to experience the content in focus in a mutual activity (Otterborn et al., 2024; Walan & Enochsson, 2022). The result has also shown that other props, such as binoculars, hula hoops or animals and plants made of plastic, have been given a significant role in play. Props that have been used to create rich play experiences or as a way of introducing cultural tools in play (Pramling et al., 2019).

There are examples of play where the participants pretend to be far away, like in the jungle or under the surface of the ocean. However, there are also examples of play that are connected to science content, in which the children have their own experiences, such as those playing in the woods or by an anthill. In this way, it can be said that the projected image or video can contribute to supporting the participants in the initiated play-responsive science teaching. What becomes clear from the analysis of the preschool teachers' discussions is the need to draw attention to the importance of having discussions about how projected images and videos can be used to contribute to the development of play to broaden children's play experiences (Pramling et al., 2019), or to connect analogue and digital ways of teaching science (Otterborn et al., 2024; Walan & Enochsson, 2022). In line with Stavholm et al. (2023) the video documentation that the preschool teachers have brought to the focus-group discussions together with the theoretical framework from PRE-CEC (Pramling et al., 2019) can be seen as a starting point for creating opportunities for future discussions about these challenges. Attempts to initiate play-responsive science teaching with digital tools can be seen as a threefold challenge in encompassing knowledge about play, science, and digital tools. The challenges may lie in one or more areas,



for example, a preschool teacher not feeling comfortable joining children's play. This can be a matter of having the competence to make shifts between *as is* and *as if* or being responsive to children's experiences and communication in the activity.

However, there are also examples of the projection just being in the background, not specifically contributing to the play, or where the projection has been used to trigger a play, but where the image or video has yet to receive any further attention in the continued play. Hence, it is still being determined that the projected image or video will become part of a play. As shown above, when Sara (FG 8:O) reflects on children not using the projected image or video in their play like the preschool teacher envisioned it, it is not self-evident that the projection will be contributing.

## Conclusions and Implications

Even if the projected images or videos could be used as pedagogical tools and give the participants a mutual play experience, it becomes evident from this study that the preschool teacher has an important role. This could be said based on how the preschool teachers *trigger* play in an environment where the focus is on science content. A contribution of the projected image or video in the preschool teachers' attempted play-responsive science teaching is to create opportunities for a shared play experience or as support for the participants during play. Further research is needed on how digital tools, in general, can be used to support interaction between preschool teachers and children during play-responsive science teaching.

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## Declarations

**Conflict of Interest** No potential conflict of interest was reported by the authors.

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