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When past and new experiences meet

Negotiating meaning with 3-D materials in early childhood education

Abstract

This article suggests that the process of meaning making is closely related to embodied experience and social interaction. The article is based on a study of specific contexts of visual arts education with 3–5 year old children. The study aims to enlarge understanding of relationships between children's experience with three-dimensional (3-D) materials and their meaning-making processes. Empirical data were collected through observations of children's play and video documentation of interactions between a practitioner-researcher and pairs of children. The data were analysed through interpretative, contextual, arts-based inquiry, and the findings were presented in the form of vignettes. Two vignettes with 3-year-old boys are presented in this article, in order to discuss how the boys' explorative play with 3-D materials formed the basis for their experience, problem solving, imaginative response, multimodal expressions and meaning making. It is further suggested that the children's new understandings emerge from the 'meetings' between their past and new experiences, stimulated by the 3-D material's affordances and resistance.

Keywords: Experience, meaning making, visual arts, early childhood, 3-D materials, embodiment, multimodality.

Introduction

Body and stone

"Each thing organizes the space around it … each thing calls, gestures … for our attention", says David Abram (2007, p. 1138). In his text *Astonished by a stone: Art and the eloquence of matter*, he writes about the human body's ancient relation to nature, claiming that our animal senses do not know any passive reality – that we know the world only through interactions with it (Abram, 2007).

This article is based on an epistemological understanding that our knowledge is closely related to our embodied experience of the physical environment. In addition to social interactions, I consider interactions between children and their three-dimensional (3-D) world, in this case 3-D materials, as essential for meaning making. Through embodied interactions with our environment, we get to know about its manifold properties, as well as about the capacities of our own bodies and minds. The following quotation, borrowed from Dewey, tells about another close meeting between a man and a stone:

> A man does something; he lifts, let us say a stone. In consequence he undergoes, suffers, something: the weight, strain, texture of the surface of the thing lifted. The properties thus undergone determine further doing. The stone is too heavy or too angular, not solid enough; or else the properties undergone show it is fit for the use for which it is intended. (Dewey, 1934/2005, p. 45)

Here, Dewey describes three different processes: the action of lifting, the person's *suffering*; experiencing the stone's properties; and his reflective evaluation of the stone's usefulness. As a visual arts teacher and early childhood teacher educator, I have been interested in young children's *construction play* with 3-D materials (Trageton, 1995) and wondering: What kinds of processes take place during young children's experiences with tangible materials? How would Dewey's story sound if the stone were lifted by a child? How would a child make

meaning out of the stone-lifting activity? I offer my observations and interpretations of a young boy's encounters with stones and sculptures during our walk one September day:

> The two-year-old boy sees an angular rock that reaches up to his chest and he fights to climb on it. He tries many times, from different sides of the rock, using a variety of self-created climbing techniques, employing his whole body. When he at last overcomes the obstacle he smiles with satisfaction from the top, 60 cm above the ground.
>
> He spots a round stone, a bit smaller than a football. He tries to kick it, but the stone does not move. He tries to lift it with his fingers grabbing around it, but the weight of the stone pushes his fingers into the ground. He gets sad and angry. He probably doesn't understand why he can't lift the stone, but through his embodied experiences he might learn that rock-matter is heavier than the leather air-filled matter of a football.
>
> The boy picks and eats small, soft blueberries, and discovers some really big ones; a dozen hard blueberry sculptures, about 70 cm in diameter[1], which he doesn't try to pick. He doesn't try to lift them; he tries to push them, but realizes that they are fixed to the ground. The large round forms invite him to climb on them, and the polished surface to slide down. The surface, size, shape, mass etc. of the objects seem to encourage him to choose actions that his body, with some effort, can manage to undertake.

The two-year-old boy did not say much with words, but his actions and nonverbal expressions told about his experiences. At the moment of experiencing, complex connections seemed to be formed between his earlier and new experiences, between his senses and thoughts, between *real* problems and imagined solutions. Could a study of such experiencing moments help me to understand what Dewey (1934/2005) meant when he wrote that past experiences function as *organs* for receiving and interpreting new experiences? Did he mean to say that experiences accumulate, become part of one's body and become one with the person who carries them through his or her life? This relation between young children's earlier experiences and acquired new experiences in specific social contexts is the main focus of this article.

The article is based on a study of children's visual art activities with 3-D materials in early childhood education. The main question in this empirical study was: How do children make meaning *about*, *because of* and *with* the available 3-D materials? Specific contexts were facilitated in which pairs of young children (aged 3–5) were given a chance to explore and play with 3-D materials. This was documented using video. From the collected data, two short vignettes have been selected for this article to provide a basis for interpretation and discussion about relations between children's experiences and meaning making.

Unlike psychologists, who have studied children in order to systematise their actions into stages and "demonstrate if children's conduct and skills are normal" (Vejleskov, 1995, p. 63), this study did not aim to measure children's cognitive, sensory-motor or other abilities. Rather, the study aimed to understand the processes behind children's actions and expressions. The research is less inspired by Piaget, who tended to ignore the influence of social interaction on learning (Ackermann, 2004) and more by Vygotsky, who "puts emphasis on *how* the presence of adults (…) enhance a child's self-directed learning" (Ackermann, 2004, p. 21). Vygotsky poses a question about relations between the individual learner and supportive others (Harry, 2001), and introduces the term *the zone of proximal development*, which is a space with potential for the learner's development (Vygotsky, 1978) through dynamic processes of negotiation with adults and peers (Harry, 2001). Emotions and desire are included in the zone (Levykh, 2008) and the importance of imagination and creativity are acknowledged by Vygotsky as essential for learning: "One of the most important areas of child and educational psychology is the issue of creativity in children, the development of this creativity and its significance to the child's general development and maturation" (Vygotsky,

2004, p. 11). In this article, I suggest that experiencing 3-D materials with emotion and imagination, as young children generally do, plays an important role in the complex process of knowledge and competence negotiation inside the zone of proximal development.

Body and mind

Arthur D. Efland (2002) writes about uneasy connections between art and psychology, arguing that the supposed division between mind and senses is artificial and faulty. Since Plato, *pure thought*, verbal language and intellectual forms of understanding have been considered superior to practical, emotional and embodied forms (Efland, 2002). Many have tried to provide evidence that the mind cannot be separated from the body and that cognition cannot be separated from experience, senses and feelings (Austring & Sørensen, 2006; Bruner, 1990; Dewey, 1934/2005; Efland, 2002; Egan, 2001; Eglinton, 2003; Eisner, 2002; Greene, 2007; Lenz Taguchi, Moss, & Dahlberg, 2010; Parsons, 2007; Smith, 1982; Sutton-Smith, 1997). Some have argued the existence of different types of intelligence (Gardner, 1983), modes of thought (Eisner, 2002), modal affordances (Kress & Jewitt, 2003) or distinct languages (Forman, Edwards, & Gandini, 1998; Goodman, 1976), and advocated for the significance of an arts-based approach to knowledge. According to Michael Parsons (2007), all the *languages*, *modes* or *intelligences* are interconnected in the human body, "for the body is where all sensory and motor systems, no matter how specialized, communicate and are integrated" (Parsons, 2007, p. 535). He suggests that thought is *embodied* (Parsons, 2007). Building on these ideas, I also argue that young children's experiences with 3-D materials can involve such *embodied thought*.

Drawing on the belief that "our body is the most fundamental tool that shapes our understanding" (Egan, 1997, p. 5), I approach the phenomenon of *children's meaning making during experience with three-dimensional materials* as involving complex processes in which experiences, feelings, memories, imagination, embodied knowledge and communication with others are all brought into play to make sense of the world.

I am aware of the complexity of this area of study, and that this can make concise description difficult. However, in order to make space for the empirical analyses, I will try to be brief and selective in my introduction, including only the most relevant concepts and methodological choices.

Framework and concepts

Meaning making and social interaction

In the study presented in this article, I prefer to use the concept *meaning making* rather than *learning.* The two concepts have much in common – both point to an enhancement of understanding and an increase of knowledge – but they build on different understandings of what knowledge is. The concept *learning* has, for a long time, been used to indicate individual processes inside a person's mind (Bruner, 1990). In a sociocultural paradigm, however, one does not see knowledge as an individual achievement, but rather as a result of social interactions. According to Bruner (1990), understanding is *situated* and *distributed*; meaning is *public* and *shared.* New meanings are made during social interactions. The knowledge that was there before the interaction takes on new meanings during the processes of expressing and sharing experiences.

The main focus in the study was on the interactions between children and materials, but these interactions also depend on the participants' expectations, attitudes and communication. Physical and social dimensions influence each other in complex ways. For Gibson (1979), the meanings of a material are discovered by a child, who experiences the material's affordances through interaction with it. Additionally, during the interaction, the

child also discovers which values are socially assigned to the material (Gibson, 1979). In this sense, Gibson's (1979) term *affordances* refers to a number of different relations: what substances can offer with their properties (plasticity, cohesiveness and so on), what social interaction can offer and what social objects, for example words, can offer. In more recent theories about senses, cognition and interaction, the term *body-mind-environment* is a concept suggested to encompass the unity of body, mind, social and physical environment (Howes, 2005). Hillevi Lenz Taguchi (2010) uses the alternative term *intra-action* to promote the notion of the mutually shared relationships between humans and their environments. She suggests that learning in early childhood takes place *between* children, teachers, chairs, books, materials etc. implying that people and objects mutually influence each other, especially if such objects (artefacts, plants, animals or materials) are the focus of teachers' and children's joint attention (Fredriksen, 2008; Fredriksen & Thorkildsen, 2008; Thompson, 2009).

To be able to understand meaning making as a shared creation of meaning that all participants can contribute to, however young they are, one must view children as competent individuals. The *New social studies of childhood* sees children as active agents in social processes (Freeman & Mathison, 2009; James & Prout, 1997). The Norwegian national *Framework plan for the content and tasks of kindergartens* also presents children as competent and active individuals who express and learn through their bodies (Ministry of Education and Research, 2006; Moser, 2009). With this perception of children, the Framework Plan requires children's active influence on the curricula and participation in meaning making. To make children's participation possible, teachers need to make space for children's embodied and imaginative ways of understanding. One possible way of doing this could be by practicing an *expansive teacher role*, where a teacher is both open to children's ideas and supportive of their observations, explorations, discussions and meaning making (Bresler, 1994). To be able to respond effectively to the particular ways that children understand, we need to learn more about how young children integrate their experiences, senses, imagination and embodied activities into their processes of meaning making.

Multimodality

The concept *multimodality* refers to types of communication where meanings are realised through more than one semiotic system (Kress & Van Leeuwen, 2006). The concept has been developed from *social semiotics* and the understanding that meaning is constructed through social interactions (Kress & Jewitt, 2003). As a field of knowledge, the multimodal approach to learning is an emerging interdisciplinary field that "requires us to take seriously and attend to the whole range of modes involved in representation and communication" (Kress & Jewitt, 2003, p. 1). However, most of the studies in this field to date have focused on the combination of verbal and visual modalities (see for example Hopperstad, 2002; Narey, 2009), and few have involved 3-D forms of communication (see for example Kress & Jewitt, 2003; Sheridan, 2009).

Multimodality is important in the study because young children, especially before they are competent users of verbal language, communicate through the body and materials and make meaning through multimodal interactions with their environment. The examples that will be presented show *how* different forms of communication simultaneously complement each other, and how the process of meaning making is multimodal.

Experience

Dewey defines *experience* as an inseparable unity of intellectual, emotional and practical dimensions (Dewey, 1934/2005). In the following text, the concept will refer to what children acquire through sensory activities with tangible materials in social contexts. I do not limit the term to *aesthetic experience* or *artistic experience* (Eglinton, 2003), since the words *aesthetic*

and *artistic* are often seen as individual achievements. This perception remains, despite argument that creativity and aesthetics can be understood as socially constructed (Haynes, 1995). I take a social constructivist position in which experience is also a *collective* phenomenon (Piazza, 2007) and research participants are active co-constructors of each other's experience, meaning and understanding (Freeman & Mathison, 2009).

A child's experience with 3-D materials is framed by a larger social context: the material already has meanings assigned to it by the culture (Gibson, 1979). In educational settings, this would mean that a teacher's creativity, open-mindedness and attitude towards materials will directly influence which meanings children are able to assign to the materials. The teacher is the one who chooses the materials' qualities, tools and techniques (Illum & Johansson, 2009), and her/his ability to imagine different possibilities delimits the extent of the children's experiences and expressions. As Eisner puts it: "When we decide what will be taught and how it will be taught, we influence, but do not determine, what students will have an opportunity to learn" (Eisner, 2002, p. 72).

The qualities of materials that are chosen for children to experiment and express with are very important. Elisabeth Nordin-Hultman (2004) reports that there is an absence of materials for explorative and constructive play in Swedish early childhood education. To make materials available is, of course, essential for the activity of experiencing, but it is also essential to allow open-ended explorations in order for knowledge to be constructed through experience (Danko-McGhee & Slutsky, 2009). To make it possible for children to acquire new knowledge and develop, teachers must support and focus on process (Eglinton, 2003). In Scandinavia, such process has been called an *aesthetic learning process*, referring to the simultaneous processes of experiencing, expressing and learning (Lindström, 2009).

As presented in the Framework Plan's curriculum area *Art, culture and creativity*, an important task of the early childhood teacher is to provide children with "a multitude of opportunities for sensory perception, experience, experimentation, creative activities, thoughts and communication" (Ministry of Education and Research, 2006, p. 23). This indicates an awareness of multiple sensory experiences and their importance for young children, but there is still much to learn about *how* the experiences with the physical environment influence children's development. The educational environment is seen as "the third pedagogue" in the public preschools in Reggio Emilia, Italy (Vecchi & Giudici, 2004). The inspiration from Italy has been significant in Scandinavia, particularly in Sweden (Lindström, 2009), and more recently, in a number of Norwegian projects concerning early childhood education. Interest in research about relations between materials and learning has been growing in the interdisciplinary field "Material Culture Studies" (Kragelund, 2005), as well as at *The Sloyd Educational Resource Centre* at Åbo Akademi in Vasa, Finland. However, there is a real need for research that can expand our understanding of how children's handling of 3-D materials can contribute to their learning and development (Johansson, 2009).

Research methods

Qualitative, interpretative inquiry

It is difficult to know what it is like to feel and think like a child. Children are too young to explain, and adults are too old to remember. We, adults, can ask children, but the questions we pose would probably become inherent parts of their answers. Is it then possible to study the processes of experience and meaning making in young children?

We can look, listen and pay very close attention in order to share the experiences of children and generate our interpretations. However, we can never *know* what they feel and think; we can only imagine and *suggest* what takes place inside their minds and bodies.

Qualitative research methods are contextual, experiential and interpretative. It is through my own experiences and reflections that I study *how things work* (Stake, 2010) within

the specific visual arts context. My interpretations are not intended as general explanations, "but as persuasion of one meaning more than another" (Stake, 2010, p. 25). I am aware that others will have other interpretations of the same events, but I am also aware that the inevitable subjectivity of my interpretations should not make them any less important (Stake, 2010). An experiential researcher and "multiple interpretations provide a depth of understanding that the most authoritative or popular interpretation does not" (Stake, 2010, p. 66). In arts-based educational research (Bresler, 2007), subjectivity is not seen as something to be eliminated, "but as an essential element of understanding human activity" (Stake, 2010, p. 29).

Arts-based educational research is characterised by its capacity to generate new questions rather than answers (Barone & Eisner, 2006). My interpretations of the visual arts contexts may help us pose new questions about children's meaning making and about the purpose of visual arts education in early childhood.

Data construction and analysis

Before this study was conducted, I had the opportunity to spend time in a specific preschool and become familiar with the children and teachers. A short pilot study was conducted, in which I observed teachers and children engaged in visual arts activities. None of the teachers were trained visual arts teachers. They were improvising based on their "assumptions about the nature of art and arts education" (Bresler, 1994, p. 98). I knew there was much more that visual arts could offer young children. However, as long as the teachers were not supporting the children's experiential, imaginative and explorative play with materials, my observing them could not help me to answer my research question. Additionally, if I were to study children while they were interacting with their teachers, I would also be studying the teachers, because adult-child relationships are shaped by children and teachers' expectations of each other (Freeman & Mathison, 2009). Since the focus of my study was on *children's experiences* and not on the teacher's competence, I tried to find a better way to get closer to the children's experiences.

From my understanding, meaning making is contextual and dependent on social interactions. It was therefore necessary to observe children's interactions with materials *while* they were interacting with other children and adults. Instead of observing the teachers, I decided to interact with the children myself and film the social and physical interactions with a stationary video camera. As a participant, I could make sure that the children had the opportunity to explore 3-D materials. I also had a chance to act like a *connoisseur* – someone who appreciates visual arts, can experience complex qualities of visual arts education and is capable of making judgments about the qualities experienced (Eisner, 1991). I would endeavour to be attentive, supportive and fully present, since "teaching arts adequately requires sensitivity, improvisation, and an ability to respond well to the unpredictable" (Egan, 2005, p. 50).

The process of data collection, or rather data construction (Alvesson & Sköldberg, 2009), was organised as a multiple case study. The empirical study was conducted in one random Norwegian early childhood institution for children aged 0-5. I chose to focus on 3-5 year old children and started the study process by observing them in their outdoor and indoor activities, free play and planned activities. Through these nonparticipant observations I collected information about the children's interests and preferences in materials, playmates and types of play. Based on these observations, I planned and prepared visual art activities with 3-D materials for pairs of children. These sessions became the contexts for my participant observation.

The process of nonparticipant and participant observations was repeated nine times, forming nine separate, but not independent cases. Different children took part in each of the

cases and different materials were used. The common factor for all the cases was that the children had the opportunity to explore 3-D materials in organised social contexts. Robert Stake explains: "In multicase study, the single case is of interest, because it belongs to a particular collection of cases. The individual cases share a common characteristic or condition" (Stake, 2006, p. 4).

My observation notes and the videos were later developed into field accounts, each of them describing how the 3-D materials and the children were chosen, and how the content for visual art activities was planned and organised. The video material was analysed through *NVivo8* software for data analysis. The children's activities and observable expressions of all kinds (gestures, facial expressions, pointing etc.) were coded across the cases. From the type and density of the coded sections, I could identify themes that emerged across the cases. The themes I found most interesting were those that initiated reflections and new questions. Such themes are referred to as issues. According to Robert Stake an issues is "a problematic theme having tensions and advocacy" (Stake, 2010, p. 219): The four main issues that emerged across the nine cases were:

1. The large diversity and frequency of *embodied activities* during the children's exploration of the materials
2. The *materials' qualities* inspired the children's imagination, associations and expressions
3. The *materials' resistance* seemed to stimulate children's problem defining and problem solving through negotiation with the materials
4. The huge *influence of context and intersubjectivity* on the children's experiencing activities and meaning making.

Similarly to Vejleskov (1995), who found that children's utterances during their play with LEGO were dependent on their nonverbal behaviour and physical activity, I also experienced that 'my children's' expressions were highly multimodal – the experiences and expressions were simultaneous and merged. I therefore found it necessary to analyse single episodes contextually, so that one child's experiences and expressions could remain connected. Having identified the four main cross-cutting issues, I turned my attention to each of the cases individually, to interpret the episodes that were most significant for understanding the issues. In this second phase of the analysis process, I constructed vignettes and analysed them contextually. Much more could be written about the methods and the four issues. However, for the purpose of this article, I have chosen to present two vignettes which are relevant for understanding of the third issue: children's negotiation with the material's resistance. (The research methods are presented more comprehensively in a forthcoming journal publication[2].)

Presentation of data: The events that helped me to understand

The two events I will describe took place in two different contexts. By chance, both examples involve boys, even though the number of girls and boys in the study was almost the same.

Stamping on clay

> Two three-year-old boys and I are sitting at a table in a meeting room we borrowed for the occasion. We've been exploring clay for 30 minutes, squashing it into the table, making prints in it with stones and shells, and talking about different ways to make it flat. We are now looking at a large piece of clay with a smooth surface. I try to initiate a conversation about the clay's flatness and smoothness: "How can we make it so smooth?" One of the boys, who I will call Helge (3 years, 1 months, 3 days), says that he once used a rolling pin.

I fetch a large, adult-sized rolling pin from under the table, where I am keeping tools and objects not yet introduced. The other boy, who I will call Tom (3 years, 0 months, 18 days), does not speak much, and when he does his words are difficult to understand. Tom spontaneously takes the rolling pin from my hands and starts to roll over the piece of clay. I help him to press the rolling pin down. Suddenly, he lifts it up and I quickly remove my hands. While he is holding the rolling pin with both hands above his head and with pride looking at the clay he says: 'Aaaa!', which, in this context, can be understood as: 'Look what I've made!'. I repeat his word and add: 'Look at that! *You* made it!!!' I also ask him something about the rolling pin, but he does not seem to hear me any longer. Tom is now holding the rolling pin in front of his face and looking at it. Then the look in his eyes becomes absent; he seems to be thinking about something else and does not hear me.

He slowly puts the rolling pin down on the table and interrupts me in the middle of my sentence: "Aaaa… allo….alle aaaa…." He turns in the chair as if he were climbing down, looks at the floor and continues: "Aaa….pramme!". The moment he finishes the word (which does not mean anything in Norwegian) he turns his head and looks at me, as if he were asking me something.

I bend forward to hear him better: "What are you saying? What do you want to do?"
Tom: "Aa pramme igjen!" ("to *pramme* again")
I repeat what I believe he says: "Aa pramme igjen?"
Tom: "Yes!"
But I do not understand him and I ask Helge (who is Tom's best friend and, although the same age, used to translating when people don't understand Tom): "What does that mean? Can you help me to understand?"
Helge: "No!"

I turn to Tom again: "Do you want to do something *now*?"
Tom: "Trappe igjen" ("Step again") and starts climbing down from the chair, at the same time as I walk around to help him get down.
I ask again: "Pramme – what does that mean?"
Immediately Tom gets down on the floor, he starts stamping on the floor with both feet.
I say, surprised: "Trampe!?" ("stamp") "You want to stamp on the clay?" He seems to be thinking about something while I am waiting for his answer. I suggest that we should take our socks off and stamp on the clay. He says "yes", and we all do that.

Finger protection

Two boys and I are in a small bicycle shed just outside the early childhood centre. The bicycles have been removed, other things brought in, and the room now looks more like a wood workshop. There are large branches and roots on the floor, and some wooden sculptures, planks, tools, rope and masking tape on the shelves. During the hour we have already spent here, the boys have been sawing, whittling with a knife, talking to the video camera, and binding and taping different things in the room.

When Espen (3 years, 4 months, 25 days) is holding the knife, I stand behind his back and cover his left hand, which is holding the small plank (in order to protect his hand from being cut), and with my right hand I help him press the knife down in order to cut small chips off the wood. The moment I look at what the other boy (here called Morten) is doing, the knife slips and cuts a finger on my left hand. It is just a little cut, but I react surprised: "Oh that hurts!" I put the knife on a high shelf and suggest that we should do something else.

Some time later, Espen finds a wooden knife, which I had brought in as an example of something that has been whittled. He suggests that he could whittle with it and he tries doing that for ten minutes or so. He is working hard, holding the wooden knife just in the right position and whittling in different directions, but this does not work in the same way as the real knife. "There is just dust coming off", he says and laughs. He leaves the knife and the plank and looks for something else to do.

He finds a roll of masking tape, and both of the boys get very interested in tearing the tape and taping things. The tape is not so easy for them to tear. Sometimes it crumples up and

sticks together. They cooperate, ask me for help, and they teach each other how to tear. While I am busy with Morten, Espen suddenly shows me his index finger. There are thick layers of tape around the finger:
Espen: "A..a..a… I pretend.... Made bandages!"
I look at him and say with surprise, "Ow!.. Around you finger!" and laugh.
He shows me his finger proudly: "Look at it!"
I say: "Now you have protection on you finger... You cannot cut yourself... Your finger is protected..."
Espen: "I have like this.... Like Eva's grandfather!"
I: "Eva's grandfather?"
Espen: "Yes."
I: "Does he have something like that?"
Espen: "These are bandages."
I: "Oh… (affirmatively). Does Eva's grandfather have bandages on his finger?"
Espen: "Because he injured himself."
I: "How did he hurt himself?"
Espen: "In the mountain."
And I confirm: "In the mountain..."

A little later, Espen approaches Morten and bends his head, so that his face almost gets between Morten's face and his busy hands.
Espen: "Then I cannot cut myself!"
And once again proudly and laughing: "Now I cannot cut my finger Morten!!"

Discussions: When past and new experiences meet

Meaning making as sudden discovery

There are surely many reasons why things work as they do, and those reasons mutually interfere with and affect each other (Stake, 2010). I aim to interpret the two specific events contextually (Graue & Walsh, 1998) and seek to identify some of the causes that might have influenced the processes involved in the children's meaning making. Since experience is not visible, I could only observe the children's activities and expressions. I could raise questions about them, and make my own interpretations in order to conceptualise what kind of processes accompanied the children's embodied activities and expressions. On several occasions, when I looked very closely and with empathy, I could identify moments when illuminating ideas seemed to be born in the child's mind, for example, when Tom had the idea to stamp on the clay. In such moments, the child makes new meaning about the material's qualities, the possibilities of his own body and about social relations. The moments of sudden insight seem to last for just a few seconds, but still involve many different simultaneous processes. In this text, I call these sudden moments *discoveries* because they happen so fast. These small discoveries cannot be compared to large scientific discoveries that have extensive consequences, but they still have vital importance for the child. In a similar way to *children's theories* (Samuelsson & Carlsson, 2003), children's discoveries are small steps that can lead them to a larger, broader and more complex understanding.

Tom's discovery

This was Tom's first time playing with clay. He used stones and sticks to hit the clay. He pressed the clay between his fingers and against the table. He experienced the plasticity of the material and how it changed its form under pressure. We spoke about making the clay flat and a rolling pin was introduced, on Helge's suggestion, as a flattening tool.

When Tom pressed the rolling pin over the clay, the material yielded. I helped him to push the tool against the clay, while he made the rolling movements. When he suddenly lifted the rolling pin and looked at the clay, to see if it had changed, and at me waiting for my reaction, something seemed to happen in his mind.

First he smiled, expressing his pride, then, the look on his face changed, as if his eyes focused on something on the wall. His gaze became distant; it was obvious that he was thinking about something outside of the context. For a few seconds, he did not hear or see what was happening in the room. The specific facial expression spoke of total engagement with something he had on his mind. At that moment, the idea of stamping on the clay seemed to be born. How did this happen?

It is impossible to know what happened in Tom's mind at the moment of the illuminating idea. What came first? Formulation of the problem: *How to make the clay flat*, or a memory in which he experienced how sand, snow or mud changed under his feet? Possibly the problem formulation, the memories and the problem solution all happened at once. But where could such motivation and energy come from?

Dewey suggests that some kind of energy transformation takes place at the moment when new and past experiences meet; that: "transformation of energy into thoughtful action, through assimilation of meanings from the background of past experiences" (Dewey, 1934/2005, p. 63) takes place. The process of experiencing the clay seems to have affected the child's sensory awareness (Eglinton, 2003). This new awareness made him remember his earlier experiences with material of similar qualities and his embodied knowledge of sinking through a soft surface. The new experience with the clay reminded him of the memories that were earlier collected through the activities of his body (Otto, 2005). This junction of the new and past experiences resulted in a *thoughtful action*: the suggestion to stamp on the clay.

In order to practice the activity he had imagined, Tom had to express the idea and to ask for permission to stamp on the clay. His multimodal expressions; attempts to say the word "stamp" and his foot-movements, therefore, had a social function. His expressions were both questions and suggestions. When he said the word "pramme", I experienced it as a question, because he looked at me each time he pronounced it. His expressions were more determined and self-confident initially, and then gradually his self-confidence sank each time I failed to understand him. Edith Ackermann refers to Papert, who was "stressing the fragility of thought during transitional periods" (Ackermann, 2004, p. 20). Tom's *thoughts in transition* seem to be fragile and needed my support to be completed. I do not know if my repeated questioning in order to understand him functioned as support, or as an indicator of the uneven power balance between us. Still, Tom kept trying to make himself understood. This tells me something about his self-confidence, will to share his thoughts and his curiosity to find out what happens with clay when one stamps on it.

What someone chooses to make meaning about tells us what her/his interests are at the moment of representation (Kress & Jewitt, 2003, p. 13). That Tom chose to suggest stamping on the clay can tell us that he was interested in the clay's capacity to change form under pressure. It is possible that it was precisely the clay's resistance that awoke his curiosity to search for an easier way to press it flat.

The clay was the object of joint attention (Thompson, 2009), and its plasticity was the basis of the communication between the three participants. Since children feel competent when they can contribute or assist others (Dysthe, 1999), the communication context in itself could have motivated Tom to suggest how clay could be treated, and through this comment make a valuable contribution to the conversation.

Espen's discovery

In Espen's case, the relationship between his new and past experiences seems to be more complex. His new experiences, gained from the activities of whittling and experimenting with the masking tape, were connected to his earlier experience of bandages on someone's hand. The complexity of his case was also greater, because Espen made a few different attempts to solve his problems.

Espen was interested in tools and enjoyed using the knife. When he experienced my finger injury and my response of taking the knife away, he was slightly frightened. However, he did not want to give up whittling; he did not ask about the knife until later, but found the wooden knife and continued to whittle the same piece of wood with it. When he remarked that whittling with the wooden knife resulted in a lot of dust, I did not assume that he was complaining; he was laughing, but this remark could also mean that whittling with the wooden knife was not effective. This resistance of tool and material was probably what he experienced during his 'dialogue' with both (Illum & Johansson, 2009). The fact that he still continued with the activity tells me about his motivation for whittling. His desire to use the knife and his fear of it together seem to be a source of his motivation to solve two self-defined problems: *How to use the knife without cutting one's fingers?* and: *How to get permission to use the knife again?*

The experiences with the activity, the hardness of the wood (even though it was soft balsawood) and the sharpness of the knife were Espen's new experiences. When he apparently gave up whittling and started to play with the masking tape, he also gained new experiences with the tape's qualities.

Tape is usually not seen as a 3-D material for construction play, but rather as an additional remedy in work with two-dimensional materials. Since children's experimenting with materials can be considered waste, I suppose that Espen likely did not have the opportunity to experiment with this type of tape earlier. Christina Thompson (2007) says that children create new meanings when they are given the possibility of improvising with materials. Espen tested the tape's properties and improvised with it for a long time before he came up with the idea to protect his finger. The tape was off-white, sticky on one side and paper-textured on the other. It was about two centimetres broad and could be torn in chosen lengths. The specific qualities of the tape seemed to remind him of bandages and his past conversation with Eva's grandfather, who had bandages on his hand. Some kind of internal negotiating of meaning seems to have taken place in his mind at the moment of his previous experiences merging with his new experiences and combined with his desire to use the knife. Vygotsky suggests that at such moments of internal connections, our brain "creatively reworks elements of this past experience and uses them to generate new propositions and new behaviour" (Vygotsky, 2004, p. 9).

I do not know when Espen got the idea to protect his finger. It could be that the idea came first, or perhaps he accidentally got some tape on his finger and this gave him the idea. Since experience and imagination are mutually dependent (Vygotsky, 2004), either suggestion is possible. The video shows that wrapping the tape around the finger took only 20 seconds, and that the wrapping was done with his full attention and competence. Possibly, the competence was also a result of his improvisation, experimenting and experience of how careful one has to be to prevent the tape from curling.

Espen's meaning making was a continuous process in which new experiences, thoughts, feelings and memories interacted with each other during the negotiation of meaning. The new experiences with the knife and the tape seemed to revive his memories about the man with bandages. His testing the wooden knife and wrapping his finger, which were attempts to solve problems, also led to new experiences. According to Eglinton (2003), children experience, discover and create during "artistic processes". The experience leads to other experiences and motivates further investigation. During this process, children undergo *personal transformations*, construct new concepts, acquire skills and develop aesthetic competence (Eglinton, 2003). Furthermore, as Dewey (1934/2005) notes:

> The junction of the new and the old is not a mere composition of forces, but is a re-creation in which the present impulsion gets form and solidity while the old, the "stored" material, is literally revived, given new life and soul through having to meet a new situation. (p. 63)

The *stored material*, the earlier understanding that bandages can be used if one is injured, has been endowed with a new meaning in the situation, which required protection from the sharp knife. The new meaning that Espen assigned to bandages was that they could be applied *before* one gets hurt. And the masking tape was given new meaning when it was used to represent bandages.

The mutual influence between Espen's experiences was established through his imaginative, associative thinking. According to Egan (2007), imagination plays an essential role in learning[3], or meaning making, because it allows flexibility of mind. It was the imagination that enabled Espen to make connections between a broad spectrum of experiences, but imagination was also necessary for him to express and be able to produce something new. He first had to imagine possible solutions. Imagination is the basis of all creative activity (Vygotsky, 2004).

Imagination is a form of thinking that has an important cognitive function; it enables us to imagine possible ways of doing things in *our mind's eye* (Eisner, 2002). When pre-school children enjoy "sheer explorations of sensory potential of the materials they use" (Eisner, 2002, p. 5), their experiences with materials can stimulate their imagination. In this way, Tom imagined he could flatten the clay by stamping on it and Espen imagined he could protect his fingers by bandaging them. Unfortunately, imagination is usually not seen as an important part of the process of meaning making. In this respect, Brian Sutton-Smith (1988, p. 7) poses an important question: "What if the imagination is primarily not mere fancy or imitation, but is itself thought's direction?"

The wrapping of the finger was a 3-D product of Espen's meaning making. It was his personal solution for the problems he was facing. The motivation was not given externally, in the form of an assignment telling him what to make, but it came from his desire to use the knife again, and to use it safely. Dewey (1934/2005) argues:

> There is no expression, unless there is urge from within outwards, the welling up must be clarified and ordered by taking into itself the values of prior experiences before it can be an act of expression (p. 64).

In addition to his expression through the material, Espen also expressed himself verbally. His voice was proud and he had a large smile on his face when he addressed me: "I made bandages!" and later told his friend the wonderful news: "Now I cannot cut my finger, Morten!!"

Eventually, he wrapped the index finger on the other hand as well and when he asked me to use the knife, his fingers were protected!

Conclusions and further questions

3-D materials' contribution to meaning making

When Tom and Espen were given the opportunity to make their own choices in their explorative play with the 3-D materials, they experienced the possibilities and limitations inherent in the materials. They were sensitive to the materials' qualities, as we are *bio-logically designed* to be (Eisner, 2002). Further activities were determined by the specific material's *affordances* (Gibson, 1979) and resistance (Dewey, 1934/2005). In both examples, the specific material's qualities provided the boys with certain possibilities (Gibson, 1979). Clay could change form and tape could be wrapped around something. In addition, the fact that something was difficult to do in the given context seemed to be even more motivating.

Perhaps it was because it was hard to press the clay flat that Tom came up with the idea to expose it to the weight and force of his body? It may be that he did not understand why it was hard to press the clay with his hands, and he recalled how easy it was to stamp a snowball flat? What if it was exactly this peculiar combination of a past understanding and something not yet understood, that provoked his thoughts (Dewey, 1910)? Could it be the resistance of the tool (the knife) and the *social resistance* (permission to use the sharp knife) that initiated Espen's problem solving? Dewey (1934/2005) comments:

> The only way it [impulsion] can become aware of its nature and its goal is by obstacles surmounted and means employed; (…) Nor without resistance from surroundings would the self become aware of itself (…) resistance that calls out thought generates curiosity and solicitous care, and, when it is overcome and utilized, eventuates in elation. (p. 62)

What if education that appreciates children's experiences with materials can release unknown possibilities for the development of their minds and bodies? And what if materials in themselves have potential to *invite* a child into the *zone of proximal development* (Vygotsky, 1978)?

A few closing comments

We tend to understand *thought* as something opposite to what is directly perceived (Dewey, 1910). However, my examples show how the direct act of perception influenced the children's thoughts. The fact that Tom suggested stamping before he was familiar with the word "stamping" may imply that he was not thinking in terms of words, but in terms of embodied experience; he was thinking simultaneously with his hands, feet, senses and brain (Vecchi, 2007). As if there were a constant oscillation between the thought, the word and the experience (Vygotskij & Kozulin, 2001), Tom was sharing his experiences and thoughts through multimodal expression, during which the understanding of a new word was developed.

Meaning making is not an isolated linear mental process, but a number of complex processes, dependent on embodied relations, on physical and social contexts, on space and time. Some experiences, thoughts and fantasies are 'old' and settled within the body. Others are new and are being constantly acquired. As Egan (2007) describes:

> In the process of learning, the student has to fit whatever is to be learned into his or her unique complex of meaning-structures that are already in place. This requires restructuring, composing, and reassessing of meaning. (p. 13)

When a meaning has been restructured internally, it has to be further shaped during the process of expression; it has to be adjusted to the properties of the expressive media (wood, masking tape or verbal language) and to be negotiated within the social context.

If I were to simplify the infinite complexity of the *process of meaning making* during explorative play with 3-D materials, I would do so in relation to the events discussed above. I have identified at least four different processes involved in the children's meaning making: 1) the process of experiencing 3-D materials within social contexts; 2) the process of the imaginative activity of connecting new and previous experiences; 3) the process of reshaping meaning through interaction with the materials' qualities; and 4) the intersubjective process of expressing, sharing and negotiating meaning through social interactions. The processes were on-going, interdependent and contextual, but also personal. Taking into consideration the human ability to remember and to imagine, the processes were also stretching back and forth in time, making each child's meaning making and expression a unique achievement with a highly *personal signature* (Eisner, 2002).

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[1] The sculptures are a part of the sculpture park "Sti for øye" ("Path for the eye") at Fossnes in Stokke, Vestfold, Norway.
[2] The article "Researching interplay between 3-D materials and young children in socio-cultural contexts" was resubmitted to TechneA in February 2011.
[3] Egan uses the word *learning.*