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Learning to learn: What can be learned from first-hand experience with materials?

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Abstract: A child cannot be taught how to walk – it has to sense the balance of its body, the smoothness of the floor, the strength of its muscles, and respond appropriately. The author argues that the process of learning depends on embodied functions and subjective experiences of the one who is learning. This paper discusses the first-hand perspective in the process of material transformation. During such a process, the acting person has to be attentive and make innumerable adaptive choices. Examples from a doctoral study focusing on young children (3 year olds), illustrate how the children's first-person experiences related to their learning. The author proposes that similar processes take place at all ages and that experience of learning through material transformation is an arena for learning how to learn. The paper initiates discussion about interactive relationships between the senses, attention, emotional engagement, responsibility, mastery, self-confidence and learning during material transformations.

Keywords: Experiential learning, first-hand perspective, materials transformation

1. Introduction and methods

1.1 The purpose of the paper

In the present time in human history, when we regard our modern societies as well developed and superior to human life in past centuries, our brains' genetic character has not changed for ten thousand years (Mithen 1996). Our genes remain deeply grounded in our much older evolutionary past (Tunstad 2015). Evolutionary psychology posits the existence of innate interests, capacities, tastes and other universal features that have been, and still are, essential for human life (Dutton 2003). Competence to make sense of experience is one such feature essential for survival. Similar to other animals, we have biological, embodied predispositions to learn through interactions with our physical and social environments (Gibson 1979). However, specific anatomic and physiological characteristics of the human

body have made it possible to develop particular forms of reasoning (Egan 1997, Moser 2010); walking on two legs liberated hands and made material transformations possible, and in the next turn, the challenges that hands were exposed to, invoked development of the brain. Handcrafting has had, and still has an essential role in cognition.

Cognition is embodied (Parsons 2007). Our movements and actions are in multiple ways connected to our brain activities (Rizzolatti and Sinigaglia 2008). Handling of an object or material activates many different functions in the brain (Damasio and Lie 2002). Behind any simple action, as for instance picking up a cup of coffee,

> "lies a complex intertwining of sensations (…), motivational connections, body arrangements, and motor performance, not to speak of postural adjustments (…) and the role played by the learning process and the know-how we have acquired in identifying, localizing, reaching for, and grasping objects in general" (Rizzolatti and Sinigaglia 2008, p 2).

Engaging with different forms of actions, movement and experiences, disregarding how small they are, the actions contributes to the building of an individual's repertoires of sensations; the same repertoire is essential for recognition of actions of others (Rizzolatti and Sinigaglia 2008). Consequently, our embodied actions are both connected to our brain activities, but also decisive in directing the ways we function socially and emotionally. Biological, social, individual and cultural sides are intertwined – we are cultural by nature (Rogoff 2003) and our learning depends on both social and biological factors.

I present cultural context, dazed by luxury of modern living and a narrow-focused view on human evolution, we often assume physical activities with tools and materials to be unnecessary. In a rush for "theoretical knowledge" [1] some educational systems don't value children's crafting activities. Few parents want their children to deal with "old-fashioned" manual labour when they get older. However, the main objective of engaging with art and craft in pre-schools and primary schools is not to prepare children to become a crafts person or an artist (which of course they can become), but to provide them with experiences that challenge their attention, choices of action, ability to solve problems and to help them develop creativity, ability to take initiative and responsibility. This paper intends to show how activities involving material explorations have the capacity to engage children in multiple ways. The complex processes are impossible to grasp and comprehend directly or describe in a single paper. Many questions will remain unanswered in this paper, but the paper will hopefully initiate curiosity about the complexity of the process of learning/meaning construction.

Building on a qualitative study of educational settings with young children, I will present examples that show how simple actions of material manipulations can contribute to

[1] I use quotes here because in my view theory and knowledge are deeply rooted in embodied functions.

personal growth and awareness of what it means to learn. The paper suggests that it is specifically the self-initiated action that is a source of and a driving force behind learning[2].

1.2 Methods

As a visual arts teacher on programmes for teacher education in Southeast Norway, one of my responsibilities is to facilitate students' learning through processes of making, in such a way that they are capable of facilitating learning for young children. During the years, I have conducted research projects with young and adult students targeting the same theme: experiential learning through explorations of unstructured materials[3].

My doctoral study Negotiating Grasp addressed the research question: How do young children (3-5) make meaning during their play with three-dimensional materials? The methods applied in the study fit into arts-based education research methodology (Barone and Eisner 2006, Bresler 1994, Bresler 2006a, Eisner 1991). The data was collected while I interacted with children during visual art activities as an A/R/T-ographer (Irwin 2004, Irwin and Chalmers 2007) where roles of an artist, teacher and researcher merge. Nine educational contexts (cases) were filmed and analysed.

Table 1 Overview of the cases

	Children's age: years, months, days	Materials	Video length
Case 1: Woodwork	Boy, Emil 3,4,25 Boy, Morten 3,9,3	Branches, planks, string, tape	52 minutes 23 seconds
Case 2: Pink textiles	Girl, Eva 3,4,17 Girl, Marit 3,4,19	35 different types of textiles, in shades of pink	58 minutes 23 seconds
Case 3: Clay play	Boy, Helge 3,1,3 Boy, Tom 3,0,18	12 kg of soft clay	61 minutes 31 seconds
Case 4: Clay and yarn	Boy, Brede 4,5,8 Girl, Pia 5,5,23	Two similar installations, one made of clay, the other made of cotton yarn in the same color, shape and texture	57 minutes
Case 5: White yarn	Boy, Even 4,11,2 Boy, Markus 5,6,22	11 yarn balls of the same size, different textures, softness, small, yarn thickness etc., and a circular knitting machine	59 minutes 15 seconds
Case 6:	Boy, Thomas 5,5,8 Boy, William 5,4,9	78 cardboard boxes of different sizes and shapes	43 minutes 20 seconds

[2] Learning is here understood as individual (yet social) meaning negotiation/construction.
[3] Like wood, sand, clay etc.

Cardboard boxes			
Case 7: White sand	Girl, Line 3,10,3 Boy, Are 3,10,12	White clay-like sand and normal sandpit-sand	50 minutes 40 seconds
Case 8: Building with Wood	Boy, Alexander 5,5,11 Boy, Terje 5,2,16	Large number of plank pieces in geometric shapes	60 minutes 4 seconds
Case 9: Blue wool	Girl, Stine 4,6,11 Girl, Pia 5,6,27	Brushed wool in 7 shades of blue	43 minutes 15 seconds

The close contact with two children at a time during the unfolding contexts, as well as detailed analysis of the films, uncovered the complex processes of the children's experiencing and expressing. The data were first analysed using cross-case methods (Stake 2006), with the help of software NVivo9, and later analysed contextually in-depth. The specific interactionist approach, where a researcher seeks to understand a certain phenomenon on the basis of their own experience (Järvinen and Mik-Meyer 2005) made it possible to grasp the processes from the "inside" and understand the children's embodied competences and biological urge to explore, find out, solve problems, welcome challenges and learn by doing. Empathetic engagement, shared activities and common experiences allowed a kind of "mutual absorption" (Bresler 2006b) between the participants (myself and the children) and led to new insights.

The study was interdisciplinary and epistemologically grounded in social constructivism, which is a position where individual and social influences on learning are equally acknowledged (Freeman and Mathison 2009). The influence of materials' advocacies was also considered as central. The study uncovered highly contextual and individual nature of the children's learning processes. At the same time, it revealed embodied capacities that were similar among the children's learning processes.

When an adult deals with materials, tools or techniques one is familiar with, many movements and actions, which seem obvious to them and therefore pass unnoticed. While much of the knowledge developed in an adult's process of making often remains tacit (Niedderer 2013), young children show how their learning processes unfolded during material manipulations. Even though they were not able to express verbally, the children expressed their thoughts in other significant ways. Unlike most adults, the children were not restricted by assumptions and expectations, and they were not embarrassed to share their discoveries - thus much of what they experienced were discoveries that surprised them and led to visibly excited expressions. The children did not act out of habit, but explored the materials with open minds. They did not constrain their expressions, on contrary, their vivid expressions mirrored their experiences and uncovered processes usually invisible, supressed or unconscious in studies with adults.

2. Theory

The theoretical framework of John Dewey has a central role in this paper. However, the framework is extended and up-dated with more contemporary research literature. Combining different theoretical views can become complicated, but was necessary to interpret this study in a holistic manner.

We humans are biologically designed to be sensitive to nuanced qualities of objects and materials that surround us (Eisner 2002) and we know the world through our bodies (Shusterman 2008). Dewey described the process of transforming materials in the hands as intertwined with the process where internal "transformation takes place on the side of 'inner' materials, images, observations, memories and emotions" (Dewey 2005 [1934], p 77). He emphasises the close relations between physical actions and mental processes. The environments we inhabit provide us with sources of experience as well as potential for action (Sanders 1999); when we act we acquire experiences through our sensory-motor systems and our sensations influence our thinking and doing.

Transforming material with the hands engages mostly the visual and touch senses. The sense of tough is our most subjective sense (Stenslie 2010). Activities of grasping, holding or touching cannot be performed without the engagement of this tacit sense. Also muscles, joints, tendons and other parts of the body are activated inside the person who is performing the activity so that s/he can experience somatic sensations[4]. Such sensations are only accessible from a first-person perspective. The first-person perspective allows meaningful dialogues between the person and his/her environment (Stelter 2008).

All humans have an inner need to act upon their own environments (Merleau-Ponty 1962) - young children express these needs openly. Through diverse activities they acquire and accumulate experiences in their bodies. In the next instance, their possibilities to think and make decisions depend on the repertoire of their accumulated experiences (Dewey 2009 [1909]). Personal understandings emerge from negotiations between present and past experiences; meanings are negotiated in a specific context. The concept of meaning negotiation can simply be translated into the concept "learning", but not the form of learning that is a linear process of knowledge transmission between teacher and learner. The concept of negotiation refers to an ongoing process of constant attentiveness toward the inner and outer affordances and challenges. A person simultaneously "investigates" the momentary affordances and challenges and makes choices about how to act. Thus, negotiation of meaning can be seen as non-linear, fluid, improvisational process of developing understanding.

During my study with young children, their negotiations of meaning often resulted in sudden, imaginative ideas accompanied by expressions of joy. Such expressions marked the children's "micro-discoveries" (Fredriksen 2011). Eisner (2002) referred to micro-discoveries as small surprises during a process of art making, where the surprise itself was the reward

[4] Shusterman (2008) speaks of "somaesthetics".

and motivation for the work done. As I see it, micro-discoveries are signs of personal discoveries through reconstruction of past and present experiences. Such discoveries can be small, but nevertheless important for the children, who come to understand something on their own. It is exactly the act of becoming aware of relation between own insights and own efforts that is essential; this awareness is a cornerstone of learning how to learn.

3. Analysis and discussion

3.1 A few examples

The children in my study were lifting the materials they were presented with, pressing them, cutting, tearing and carrying out many other explorative activities with them. They were becoming familiar with what could be done with the materials and getting new ideas about what the materials could be used for. I observed how the children used physical force and experienced the materials' resistance to their actions. I could not know what they sensed or felt, but if something did not go as expected, they expressed their surprise verbally or asked me for help. Otherwise, they did not say much and I had to observe their actions attentively. It was mostly the straining of their muscles, the way of breathing and their body language that indicated their physical efforts and intentions.

Other signs that some kind of negotiation with the materials was taking place were the children's expressions at the moments of achieving what they intended. These moments were often sudden and joyful; a child would start laughing, shouting out or would get an instant outburst of self-confidence: "Look what I can do!", "I can do it!" or "I am so clever!" Soon after they had solved the problem for the first time, they would start showing me and their peers how things should be done – suddenly they had become experts. The sudden growth of self-confidence indicated that some kind of new understanding had been achieved. The experience of gaining new understanding functioned as motivation for further searching for meaning.

Young children are capable of reading body language and empathically engaging with the experience of other people while watching them (Stern 1998). Children's observations of experiences of others are valuable second-hand experiences, however, second-hand experiences do not lead to self-confidence in the same way as first-hand experiences do. In my study, the children's expressions of self-confidence were usually connected to their physical mastering– something they had had the chance to experience through their own negotiating with materials. Here is an example:

I was showing Helge and Tom (case 3) how clay can be cut with a piece of thin string. I held a piece of string between my hands and I started to draw the string down on a large piece of clay. The string disappeared into the clay, slowly cutting its way through. The boys were so attentive that they were holding their breath. At the moment a slice of clay fell on the table in front of Helge, he started to breath and released a short laugh. I also laughed and Helge made a specific movement with his hands: he lifted both hands up in front of his chest and

opened them quickly, at the same time as he exhaled and looked at his hands. Then he looked at me and laughed again.

Helge seemed surprised at how easy it was to slice the clay. The hand movement he made was difficult to describe; I believe it was supposed to imitate the movement of the clay slice. His hands said: "Just like that!" Helge's experience of the clay slicing was visual, but also multisensory, because he could hear the thudding sound of the moist clay falling on the table in front of him and he could sense the fresh earthy smell.

The boys were suspicious: Could a string cut clay? They had experienced that the clay was heavy, while the string was thin and appeared weak. From my body language they could read patience and determination to cut; I was performing the activity extra slowly and with concentration in order to gain the boys' attention. Even though the exact activity of cutting with string was unfamiliar to them, their past experiences from similar situations made it possible to empathetically connect with my physical struggles[5]. In this sense, their past first-hand experiences were essential for understanding of their present second-hand experience of watching me cut the clay.

Through observation of my activity with string and clay, Helge became familiarised with the clay-cutting techniques, however, when he later conducted the cutting himself, more of his senses were engaged. His first-hand experience also involved his tactile sense and using his muscles. He now had to coordinate his muscles in the process of pulling between his arms, and at the same time, control his fingers which were holding the string. It was only when he was treating the material with his own hands that he could experience the material's resistance, since it is only the direct, embodied interaction with a material that can initiate thinking through the material (Dewey 2005 [1934]). Thoughts are influenced by somatic conditioning and muscular contractions (Shusterman 1999). Coordination of own body movements from the position of an actor is therefore a significant cognitive achievement. Helge's efforts can be compared to the example of lifting of a cup of coffee used by Rizzolatti and Sinigaglia (2008) to explain complex brain activities that accompany apparently simple physical actions.

Another three year old boy called Morten (case 1), experienced cutting piece of wood with a saw. Although he had never done this before (but had seen other people and me using a saw), he was convinced that he could cut a piece of wood without any help. I did not try to interfere by helping him. I only held the branch steady with my foot on top of a larger log. While Morten was holding the saw with both his hands, he could experience using his muscles. He had to explore the right position of his body in order to counter the wood's structure that challenged the movements of his saw. Once he managed a good sawing rhythm, I told him: "Oh, Morten, you have really learned how to cut with a saw!" He gave me a big smile and replied, "Yes!", and continued cutting.

[5] Helge earlier suggested that we should call his mother when he sensed that I was struggling.

Soon he showed me: “I managed to cut here”, he pointed to one of the marks he had made in the wood. While Morten was becoming competent, he was also becoming more self-confident. His growing competence and self-confidence were highly significant in the way he treated the material and the tool, in the way he spoke and moved his body, and in the way he later instructed me how to hold the piece of wood he was sawing.

Working with materials requires physical strength, both the grip of the hands and of the whole body. When Morten used the saw he had to coordinate a large number of muscles and embodied functions; how hard to press the saw against the wood, how firmly to hold the handle and so on. Through a range of different resistances, he was learning about his body, the wood and the tool, and could experience how the body-mind[6] functioned as a whole. He was gaining understanding that his own action, his own efforts, persistence and choice led to his success. He was learning how to be director of his own process of learning.

“How to saw straight”[7] and “what is appropriately soft” (Illum and Johansson 2009) are apparently simple research questions, but indeed very complex. Mastering diverse motor challenges demands many small decisions in orchestration of muscles, body position, applying strength, breath and so on according to the tool and in relation to the material’s specific qualities. Physical efforts and deep attention need to be invested in such orchestration, and when the efforts and attention lead to mastery, they are rewarded by growth of self-confidence. It is through facing something challenging that we can feel the joy of succeeding. In my study, different types of resistance motivated the children to “fight” and even search for challenges. They were looking for problems that needed to be solved particularly just after they had experienced some kind of micro-discovery, mastery or success. A feeling of mastery from one successful first-hand-experience motivated further activities, explorations and making. The newly-acquired self-confidence led to further curiosity and motivation to negotiate meanings.

Meeting a resistance, and not avoiding it, leads to development of thought (Eisner 2002). Visual art education includes a wide range of activities and materials that offer diverse forms of resistance. The process of working with challenging problems, against materials’ resistance, engages students emotionally. Suitable amounts of personal struggles are essential for negotiation of meaning and for personal growth that is transferable to other areas of life.

3.2 The significance of first-hand experience

Experience is a medium of education, but it does not come automatically: it requires an attentive and constructive mind, as well as a slowing down of perception in order to be able to be truly attentive (Eisner 2002). The young children in my research did not rush to produce something, but concentrated on performing tasks such as cutting clay and wood. They had all the time they needed. The challenges they were exposed to motivated them to

[6] This concept was constructed by Dewey (1925) since a word that integrates body and mind does not exist in English.
[7] Jenny Frohagen in Sweden conducted a study with this title.

(maybe also scared them into) sharpening their senses and dwelling on relations between their actions and the ongoing material transformation. Exploration of a material: "…calls into play alertness of the senses and acuteness of observation; (…) it requires ingenuity and invention in planning; it makes necessary concentrated attention and personal responsibility in execution" (Dewey 1956, p 128). The experience of crafting in natural materials is not just important for developing skills, but also for the development of commitment, patience, love for nature, good morals and a sense of active citizenship (MacEachren 2004).

First-hand experience with activities of crafting or with purposeless material transformation provide a valuable arena for learning to learn, because such activities teach that one has to invest effort in order to transform something – even in transforming one's own understanding. When the children were more attentive to nuances in the materials' qualities and to their own senses and actions they could learn faster and more safely (without hurting themselves). When they were attentive to what they were doing, they could become aware of the ongoing process of refining their own aesthetic attention. Eisner (2002) says that the process of refinement of perception leads to differentiation that in the next turn enables construction of diverse concepts. Furthermore, concept differentiation leads to a sharpening of the ability to notice details and discover possibilities imbedded in materials' qualities. This is true for both younger and older craft-makers. There are many similarities between Helge and Morten's attention and refinement of perception and some of my most dedicated teaching students.

When my international students on the course Outdoor Education and Experiential Learning were building tree houses, many of them had never used a saw or a hammer before. One of our discussions considered their contradictory experiences of bending nails[8]. Working in three groups on quite different house designs, two of the groups experienced that long nails bended frequently, while the third group had a similar problem, but exclusively with short nails. The differences between the groups indicated that the quality of the nails could not be the only variable. The students discussed whether this would change if they used different types of wood or hammers. Was the way one held a nail significant? They discussed the angle of hammer and the way of hitting the head of the nails. They made suggestions and tested out new ways first-hand. They realised that the height of the houses was the most significant – actually it was the way their bodies related to the house, hammer and nail. The process of the students' refinement of senses can be compared to Helge and Morten's, however in the case of the challenge with the nails the process was shared, verbalised and made explicit through group discussions. The students also described their learning through crafting in reflection assignments. One of the students, Zack, described his experience of splitting a large oak with an axe and a hammer, while crafting of a replica of a Viking boat:

> "Each of us made our own micro-discoveries and adjusted accordingly. The weight of the hammer, how best to hold it, how hard to swing it and how to swing it in order to

[8] This event has been described on my blog page http://sculpturingwords.blogspot.no

> hit the axe, were all examples of how each of us adjusted for such individual factors as physical strength and hand-to-eye coordination."

Both the young and adult students have shown that their first-hand experiences with materials provided them with possibilities to learn through experience and contribute to understanding of their own body in relation to the world. The first-hand experiences provided possibilities for mastery and increased self-confidence.

Another student, Carolina, wrote the following:

> "I think that exploring different materials helps you to get to know your body better and even yourself, because you have to learn to be patient and you become more sensitive to all the feelings you experienced while doing the activity. Furthermore, using natural materials makes you feel closer to the environment and this creates a deeper respect for it."

First-hand experience of crafting helps us understand that creating demands time and effort. It teaches us to respect both human labour and natural materials. Through the process we learn that we need to engage our own responsibility in order to initiate and carry out actions and choices. We get to experience what it means to learn and that our efforts, struggles and endurance are preconditions for any kind of change or growth. Finally, first-hand activities with material transformations make mastery possible, and it is the positive feeling of mastery that provides us with courage to face present and future challenges in order to find solutions for apparently impossible problems.

4. Challenges for the future

Learning has for long time been assumed as the brain's business, something disconnected from the actions of the rest of the body. Powerless against the neo-liberalist trends, evolutionarily inherited features necessary for individual construction of meaning, for instance inner will to act (Merleau-Ponty 1962), are exposed to the process of epigenetic changes – which is the process where genes attune to the circumstances in outside world, sometimes within the same generation (Tunstad 2015). I fear that depriving individuals of physical experience with hand-crafting threatens embodied functions (including certain brain functions) that have been necessary for survival for millennia.

Developments in digital technology make many aspects of life easier, however easy living numbs our senses and the will to act. It also deprives us of direct contact with materials, since physical hardship seems unnecessary. Today's youth seldom employ physical efforts to solve practical problems, and they miss out on opportunities for learning how to learn from first-hand perspective. They can pretend to move stones and build houses in digital games, but real straining with physical objects and materials cannot be completely replaced by digital images, in the same manner as images of food cannot satisfy hunger.

Following Eisner's (2002) suggestion that education should learn from the arts, I recommend adequately challenging crafting activities for every child or adult, who wants or needs to become aware of his or her own abilities to learn. As Carolina suggested, first-hand

experiences with natural materials are especially valuable in order to appreciate, care for and respect the natural environment. This in turn is an urgent need with our present ecological challenges.

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