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Teaching and Learning Embodied Making

A Discussion Paper Prepared for the TL&T Symposium in Vancouver, BC

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Abstract

Throughout several decades the educational research community has emphasized experiential, embodied learning with attention on the learner. However, after the Bologna/Berlin processes, politicians expect educational institutions to formulate learning outcomes, focusing on the imagined result, the specific curriculum goals, not the way there. In this text I reflect upon embodied making and learning, and why it must be included in the educational institutions to make education sustainable.

The reflection begins with a discussion of *practice* as a condition for human existence, based in Heidegger's term *dasein*. As all our experiences are filtered through practice, a disinterested study of the world is impossible. Our experience of the world will always be conditioned by our participation, our preconceptions and our interests. This way of thinking unites the mind and the body in an embodied practice, making and shaping our existence itself, not only our material surroundings and our perceptions of it. The discussion paper then turns to the topic of *experience*, and the interdependency of practice and experience. The biological foundation for our experiencing (the genes) and the way experience changes our brains (in the processes of experience-expectant and experience-dependent neuroplasticity) is introduced to expand upon Heidegger's philosophical idea of *dasein*.

Further, *learning* is discussed as a process of change brought upon by the combination of practice and experience. Drawing upon genetically sensitive educational research and motivated cognition (Kahan), the paper reflects on what is available to us and how our mere understanding of learning as flexible or not has an impact on what we may be able to learn.

The focus is narrowed down to *learning through embodied making*, the physical practice of working with materials as a three-dimensional body in a space. How do we as teachers organize, motivate and lead our student's in such processes. And how is education based on such principles still viable in today's global economics and formal education perspective? Some issues related to *teaching for learning* in this area and *research* on these topics in relation to sustainable education concludes the paper.

Presenter Bio: *Dr. Gulliksen is Associate Professor, PhD, at Telemark University College, Norway. She is Head of Studies in the Master program in Art Education, vice member of the board for the PhD-study in Culture Studies and member of the University Research Board. She is the leader of the research group Embodied making and learning (EMAL) at TUC, and a member of "Human ingenuity research group (HIRG)" originating at Western University <http://www.edu.uwo.ca/HIRG/index.html>. Her PhD is from Oslo School of Architecture and Design, and she has finished a Post Doc on Teacher Education in Arts. She is currently Guest Professor at Iceland University, Faculty of Education, Section Editor in FORMakademisk and has been Visiting Scholar at Western University, Ontario, Canada, twice.*

Metatext

The first time I presented this material, I handed out knives and small pieces of wood before commencing the talk. The audience, a group of PhD-students at the PhD-study in Culture studies at Telemark University College, whittled as I spoke. And I referred to their whittling during the talk. Afterwards the room was filled with small wooden chips all over the floor, desks and in the student's hair and clothes. The air inside the room smelled of the winter forest in which I, in the dusk the previous day, had cut down slender trees to make wooden pieces for the students. The student's hands were red and some even had blisters (although none had any cuts) on their fingers. The leading professor, a man of crystal clear intelligence and a phenomenological attitude were unfamiliar with whittling and found the absence of note-taking opportunities somewhat frustrating. Even so, he continued whittling and tried his best to enter into this woodworking state of mind. The students, by comparison, were absorbed in their carving throughout the lecture and even asked the next presenter if they may continue to carve. Afterwards one of the students approached me and explained how all the whittling marks on his wood corresponded to what I had talked about during the period by section. A memory-stick he called it. (Not the type you put in the USB-port, though).

I believe that those students experienced the talk in another way than you will experience this written text. They had our mutual physical presence and the imminence of the wood close at hand, their body was present in their listening. It is possible to argue that the sensory input informs and supports the cognitive activity, or that this input could be distracting to them. In a later study I will return to research on how whittling affects attention during lectures.

In this paper, I am presenting a narrative based on a selection of scholars within a broad area of research and theory, with particular attention on the unity of mind/body in the act of making something, i.e., embodied making. It is unfortunately only brushing the topic. Hopefully it will inspire some arguments for later, especially concerning education and learning in embodied making.

Teaching and Learning Embodied Making

Introduction



Figure 1: boy, 5y, working with skavhøvel on Viking-re-enactment marked, Norway 2012

One thing that astonishes me is that when I meet researchers within education and learning around the world everyone I meet is talking about the importance of experiential learning, inquiry based learning, learning as a process of change. Scholars like Elliot Eisner, John Dewey, Lev Vygotsky and David Kolb have approached this topic throughout the last decades. However, when looking at what the politicians expect us to do, the trend is formulating learning outcomes for our children, commonly called *deliverables*- focusing on the imagined result, not the way there. This is a result after the Bologna/Berlin processes, that, since 1999 has developed international standardisations for higher education in cycles 1 (BA), 2 (MA) and 3 (PhD). This process was initiated with the intention to emphasize student mobilization and to make it easier to recognize what a candidate should know. But it has also had the effect of focusing on learning outcomes and the end result of the education, not the process of getting educated. See http://www.bologna-berlin2003.de/pdf/bologna_declaration.pdf for more details.

In this talk, I begin by presenting some points of departure before entering into the juicier bits on learning and teaching. This entails some stating of the obvious, and some short claims or statements of large areas of research some of which I know, others not so much. I have built an argumentative outline for my talk. I will begin with the theme *practice*, then proceed to *experience*, and the interdependency of the two. I then turn to the theme *learning* as a process of change brought upon by the combined practice and experience. After a general introduction to learning, I proceed towards *learning in art and craft* – the physical practice of working with materials. I then open up some issues on *teaching for learning* in this area, and my text will end with some thoughts

on *researching* these topics, an opening up of a discussion on which topics could be central to study within this area.

Practice



Figure 2: woman, 39y, carving bowl in aspen wood, on medieval marked, Norway 2012

To do something is to act, to practice. To Heidegger doing is being – to be there. Heidegger's entrance point towards practice was through philosophy (Heidegger, 1996; 1996). His interest was to examine critically the grounds for our practice and fundamental beliefs. And his understanding behind the term *dasein* was to describe the human existence itself, the conditions under which we exist. It is a condition to human existence that we practice. All our experiences are filtered through such a practice.

Dasein also means that we have a certain intention. We do not experience a neutral world, but what we intend to do, an interested activity in order to practice. In my opinion this presents a problem for the teacher. I return to that in the end of my text.

In such an understanding an objective or disinterested study of the world is impossible. It will always be conditioned by our participation, our preconceptions and our interests. What is shown to us is shown as something. In many ways, as what we expect to see. This way of understanding the human existence is therefore also a sort of ontology of the human – a way to understand what it means to be human (what is, or can be). In turn, this way of knowing condition what we can understand and thus what knowledge is, the epistemology. This cannot be explained with concepts or theories it must be shown through practice. Heidegger's metaphor of a *workshop* is often quoted: the world, as it is shown to us through our preconceptions is only possible by understanding the context- in other words how we intend to use the information we are given. A hammer shows itself

to us as a hammer when we use it as a hammer, but we may only be conscious of it if the hammer breaks and does not work anymore (Gulliksen, 1997; 2001).

This leads us forward to the body and what it is. For centuries we have been under the doxa that the mind is something else than body. John Dewey writes:

“The very problem of mind and body suggests division: I do not know of anything so disastrously affected by the habit of division as this particularly theme. [...]The evils, which we suffer in education, in religion in the materialism of business and the aloofness of “intellectuals” from life, in the whole separation of knowledge and practice – all testify to the necessity of seeing mind-body as an integral whole.”

“The division in question is so deep-seated that it has affected even our language. We have no word by which to name mind-body in an unified wholeness of operation... consequently, when we endeavor to establish this unity in human conduct, we still speak of body *and* mind and thus unconsciously perpetuate the very division we are striving to deny” (1928/2002, p 24)” (Bresler, 2004, p.8)

Liora Bresler, among others, uses the term *embodiment* to refute this distinction. She defines embodiment as: «The integration of the physical or biological body and the phenomenal or experiential body» suggesting «a seamless though often elusive matrix of body/mind worlds, a web that integrates thinking, being, doing and interacting within worlds» (Varela, Thompson & Rosch, in Hocking, Haskell & Linds, 2001; Bresler, 2004, p7).

We can find several examples from contemporary research within the fields of practice that is influenced by this schism. Fredrik Nilsson draws up a simple taxonomy of this based on Allen, Pickering and Ryle. On one side, we have the hermeneutical practice that interprets and analyzes representations. It deals with the past and focuses on interpretation of the meaning behind this. It has a representational idiom as it represents, re-presents nature and produces knowledge on how the world is. Ryle defines this type of knowledge as *knowing that*, or in the terminology used by us now, knowledge of the mind (Nilsson, 2013).

On the other side, we have the material practice that analyses contemporary situations to create transformations towards the future. It deals with concrete matter what the Greeks would have called *hyle* and the performance. Material practice, according to Nilsson, produces concepts and theories from material and practical procedures. It is used to transform situations and used in the context of applications. It has a performative idiom, focuses on activities, and constantly involves doing things and material agency. This type of knowledge is what Ryle defines as *knowing how*. Nilsson and Dunin-Woyseth calls this Making knowledge (Nilsson, 2013). In the terminology used by us now, we say *embodied knowledge*.

Experience



Figure 3 and 4: knives: birch (top), juniper (bottom). Leather sheath. Shaft molded to fit hand. The one on top tend to cut index finger when carving.

Based in our agency and our embodied presence in the world, humans experience. Both from a psychological and a physiological perspective, experience can be described as a change. Consciously and unconsciously our nervous system registers input. This input might just as well originate as sensory input from the extra receptor system or intra receptor system, or as thoughts and feelings. Both of these are generated as electrical or chemical signals.

The basic *biological foundation* for this change is the combination of genes and experience. The type of genes we have determines our potential to change. Genes, however, do not function alone as “the ADHD gene” or “the reading gene”- they always work together in groups. And, they can be switched on and off through what we experience, although the main thesis is that: “Continuity is genetic and change is environmental” (Asbury & Plomin, 2014 p25). Genetic research and thus also what genetics refer to as *genetically sensitive educational research* also see learning as change caused by experience of the environment. They separate between what we subjectively experience (as rejection, joy, other feelings or our interpretations of incidents) and more objectively describable elements of our environment (how we live, eat, if we break a leg etcetera). In order to determine which traits come from the genes and what comes from experience, genetic researchers tend to study twins (Asbury & Plomin, 2014).

Neuroscience is another related field of study that looks at experiential changes in living beings. Neuroscience is not one science. It is a group of different approaches to study the nervous system (not only the brain, but the entire system of neurons in our body). Examples are neurophysics, neurobiology, neurochemistry, neuropsychology, etcetera. Mind you, I am no expert on either genetics or neuroscience. I have read quite much over some years, thinking I know enough to give you an introduction to the basics, but bear in mind that I may be mistaken. In this manuscript I provide some references. You are welcome to read them and engage in discussion.

Changes in the brain, in general, are referred to as neuroplasticity. Input leads to electrical or chemical signals being sent. Nerve cells, neurons, transmit electronic signals and new synapses and

also new cells are constructed as a result of those signals. Synapses are the links between neurons. Metaphorically they can be understood as trails. If one signal is a person walking this trail, and a hundred signals is one hundred persons walking this trail, you can easily visualize that the trail gets bigger where there are more signals.

Technology and especially photo imaging has made the study of neurons, mainly the neurons in the brain, explode over recent years. However, it presents a lot of problems as well. For example, fMRI technique is only usable to measure electrical signals between cells. And they cannot visualize the synapses themselves. Only pathology can do that. And not all brain cells communicate electrically. A large bulk of brain cells communicate with each other through chemical signals. This is much more difficult to study, and these glia cells have therefore not been studied as broadly. Instead they have been interpreted to be supporting cells for the other, more important, type of cells. Specialists in this area expect to learn much more when the technology evolves and makes it possible to study these chemical signals more easily.

I will not go deeper into other fallacies that may occur with a focus on imaging and studying which parts of the brain are lit up when a person does this or that. I assume you are familiar with this body of work. However, the precision of this kind of research is getting better, and has for example provided evidence that our prior conception that the left hemisphere of the brain is the analytical one whilst the right hemisphere is the creative one is a simplification to the extent that it can be said to be wrong. I therefore believe this is an important area of knowledge for us to know of and to know the limitations and possibilities.

What I want to emphasize is that what we (they) now know of neuroplasticity on a more over-arching level can inform us as educators and researchers as we understand embodied making.

Neuroplasticity is a general term referring to changes that occur in our neural system. This can be changes to the good, or changes to the worse, like the changes that come from strokes, head injuries and so on. The neural system does not have the *ability* to change, it *is* changing constantly.

There are two main types of neuroplasticity: experience-expectant, vs. experience-dependent plasticity. Experience-expectant plasticity is “the overproduction of synapses in specific areas of the brain at specific times, which are then organized and pruned by experiences that are expected or common to the human species, such as patterned light, sound, language, opportunities to move and manipulate objects, and responsive caregivers.” (Twardosz, 2012, p. 98). In education we often refer to this as “sensitive periods”. That there are stages in the development when children are more sensitive to learn something, as crawling, distinguish visual stimuli to for example recognize faces, language etcetera. This pruning of synapses makes it easier for us to discriminate stimuli. For example, does the child during its first year learn to recognize the intonation of their native language. Also, studies report that children around six months are better at recognizing and separating

between the faces on an individual level, but when they are one year older, they do not discriminate as precisely between faces from other races than their own. They have pruned the synapses not needed as often in their daily life, and therefore are able to more efficiently process some things, and less able to process other things.

Experience-dependent plasticity, however, in contrast of this pruning of overabundant connections, is involving “the modification of existing synapses or the generation of new ones on the basis of experience that are individually specific” (Twardosz, 2012, p100). While the experience-expectant plasticity has sensitive periods and usually ends around 18 years of age, this experience-dependent plasticity goes on throughout the whole life of a person. It is the process of learning and memory. The human brain is changed when learning something. The area of cells active during learning increases in size and weight due to more synapses, greater density of blood vessels, etcetera. For example taxi drivers memorizing the layout of the roads in a city, musicians playing a musical instrument, and so on (Elbert, Pantev, Wienbruch, Rockstroh, & Taub, 1995). Repetitive activity and specific training is the key.

Understanding that experience results in specific change of the brain is of course not limited to skills, but also traits, motivation, and feelings (Waldenfels, 2008).

Learning



Figure 5: Experiments in wood turning techniques after a sudden discovery that one is supposed to teach it. Linden and birch.

Now let us look at the theme learning. Although Heidegger had a philosophical angle, his perspective on practice is, in my opinion, perfectly in sync with these descriptions of neuroplasticity. The totality of practice-experience together, leads to the particular being-here or *dasein* (Heidegger 1996; 1996): that is the continual change of a person.

Building on the basic assumption that learning is change: An often used metaphor is to imagine what you know to be a glass half full of water. New information, stimuli, explanations are poured through your sensory system and cognition into this glass. This new information is not floating as a separate entity on top of the water, as a layer of oil. It is more like water in water. It changes both what was there before and what is new. I construct my new understanding of the world when adding new knowledge to old. It may be that it changes my whole perspective in a major way (condensed lemonade in water/vodka in coke), or it may be very little.

I remind you here of what Heidegger explains, that the basis of human existence is that we *are* what we expect and what we have experienced before. Truth is relative, and the human existence and human epistemology is conditioned by its historicity. As Hansen put it: We are the sum of our experiences (Hansen, 2008). With the backdrop of experience as neuroscientists see it, this historicity is the combined effort of the basic biological conditions (genes, changeable neurons) and on the input and, not the least, *that part of* the input that is available to you.

The availability and nature of the input is a central factor in such an understanding of learning. Discussion in educational research today is, as stated earlier, overwhelmingly focusing on activity, learning as an active act, with strong traditions from Vygotsky, Dewey and several more.

Yet, some things are easily changed, some are not. The term neuroplasticity only describes the change itself. As educators and teachers and even as learners ourselves, we know this. In genetically sensitive educational research they refer to three types of gene-experience correlations: passive, evocative and active, to describe how different combinations of heritability and environment access new input differently. While persons with a passive correlation tend to change little by their own accord, the active person seeks out new learning opportunities and even teaches themselves. What they discover, they want to learn.

Educational psychology research also suggests that our mere understanding of learning as flexible or not has an impact on what we may be able to learn, our entire future learning. In this text, I have focused on describing learning as change. However other theories of learning focus more on measures of prior abilities, as IQ, or talents, to assess children's potential to learn. IQ is regarded by-and-large to be a static measure. You have this quota, and it will stay that way regardless of the effort you put in.

Dweck has, for the past twenty years, studied how our understanding of learning abilities influences learning (Dweck, 2012). She explains that her research is sort of a reaction to the school system's emphasis on intelligence, and of schools/parents tendency to praise children's effort in order to give self-esteem and motivation even though neither the effort itself nor the result of it might be of high quality. In short she explains that we can have/develop certain mindsets, which are kind of psychological rules for how we experience our learning or world-perspective. She divides between two types of mindset (of course there are gradients, and you can have one type for one skill as math, and another for another skill as football). These two types, she calls *fixed mindset* and *growth mindset*.

In the fixed mindset, you *are* your abilities now and will not change. If you have the aptitude for something, learning that skill or theory will come naturally. If you have to work hard to learn something, then you are not talented in that realm and may not want to expend too much energy trying, and rather carry "I'm not a math person" as a badge of honor/disclaimer for the rest of your life. In the growth mindset, however, you think more about what you can become. If you do not get it now, you will. You can, if you put in the effort. Hard work is key.

What Dweck and her followers found in several quantitative empirical studies, is that the mindset has a stronger effect on grades than family background, intelligence or even how comfortable students feel in school. You can make your own success. They argue for teaching students to be resilient, have passion, and perseverance, and set themselves long range goals. And to believe that our mind can change and that failure is not a permanent condition.

Embodied making and learning



Figure 6. Woman, 24y, sanding bowl made from green birch, cut down with axe and carried down the hill strapped to backpack after spending the December night in a gamme (outdoor shelter).

Closing in on the topic of embodied making and learning, being a practitioner means that a pre-requisite for change and learning is to participate in the world. Physical activity opens sensory stimuli. This understanding is largely spatial. We are three-dimensional bodies in a space.

When learning through embodied making you must overcome resistance, and obstacles. You reflect best when you act and must come up with solutions. Kidd (1973) calls it 'moving to learn'. Learning to carve expands the body's possibilities. You develop knowledge of the mind/body as a spatial form in the room. You know where your arm is even though you don't look at it. You know how to knit without seeing. Repetitions are making patterns in your brain, forming it, expanding and stretching your body's possibilities.

This three-dimensional learning requires much sensory input. This type of illumination or cognitive act is the result of various and complex electrical or chemical stimuli. It also negates the notion of the brain working alone. A common misunderstanding is that illumination as a cognitive act is a result of reflection alone, or reflection as a result of reading or hearing. That is, the idea that pure thought is coming from putting two and two together, mentally. Throughout history, strong voices therefore have argued for cutting off the stimuli from the body so that it does not disturb or distract the brain to do this hard work.

The misunderstanding derives from the body-mind split. Such arguments no longer hold, as we now know more about how the gene-experience correlation leads to neuroplasticity, even on this biological level. All stimuli are sent through the nervous system to the brain, and, acknowledging it opens up learning and being-there as a three-dimensional body in a three-dimensional space.

Of course there is the issue of filtering what is most important information for me now. Some intense experiences are the result of an almost sensory overload: I suspect you have experienced one or more situations where you were totally submerged in the present. It could be on the sea in a boat in a storm, in the workshop working till the sweat pours out, in the gym working out. What happens in those situations is that many senses are sending signals at the same time. In turn this makes your experience more three-dimensional, and you will remember it as such.

To me the experience of working barefoot with raw materials in the wood-workshop is special. The small curls of wet wood left after work with the planer tickling under the toes. When looking at what I have made, even years after, I remember this feeling. I see the room where I made it, remember the smell of the wet early December snow when I felled the tree and carried it on my back down from the forest.

This leads me to another aspect of embodied making. Inherent in the practice of art and craft education, is the added value of making something, to leave traces. To some researchers this is seen as a basic human need; the need to create, the need to be seen, the need to be engaged with the natural world in some way. When you change a material, it changes you at the same time. It is a double agency, acting on each other. This feeling or state of mind is linked to materiality and motivation. Materiality will be discussed another time, but motivation I will return to soon.

Teaching embodied making and learning

What consequences do embodied making and learning have for us as teachers? First of all we need to reassess what we believe to be knowledge. Is knowledge something I have and that I can disseminate to my student? Further, how do I as a teacher remain open for student's change? In my opinion this has two main conditions or assumptions: 1) there must be room and time for the student to make, and experiment; time to let them find their own way. Time to be submerged in being-here and filter what of this information is useful for me now, which possibilities do these open for me? And, 2) the students must be given the tools to grow, to trust that they can give it a shot and if they do not succeed the first time, they will eventually. Emphasize resilience and grit.

Now, there is the problem of motivation; the interested participant described by Heidegger. What if the students have a preconceived opinion that this is bullshit? Of course we will meet such students. I am sure that some of you, that were carving just now, did find my insistence on your carving quite strange. Perhaps you have by now been given more arguments for why I thought it was a good idea, but chances are that you still are not convinced, especially if you find what I am saying really annoying or very uninteresting. All this is linked to your pre-conceptions, and your idea of who you are.

Kahan has conducted several studies on this phenomenon, and refers to the inclination that we have to fit input into our pre-conceptions. He calls this Identity Protective Cognition (2013a and 2013b). In one of his experiments he found that skilled mathematicians calculated wrong when confronted with numbers that conflicted with their preconceived view on a topic. Studying over a thousand individuals, he found that they “would use their quantitative-reasoning capacity selectively to conform their interpretation of the data to the result most consistent with their political outlooks” hence overruling their better judgment or science comprehension.

This could of course be explained by a sort of heuristic, that they did not put in the effort to think rationally and just jumped for an intuitive answer, like the one Kahneman, Tversky and Fredrick amongst others have described. Kahan, however, found indications to the contrary, that “subjects who scored highest in cognitive reflection were the *most* likely to display ideologically motivated cognition.” Such ideologically motivated cognition can thus be understood “as a form of information processing that promotes individuals' interests in forming and maintaining beliefs that signify their loyalty to important affinity groups.” (Kahan, 2013a).

Whatever the reason, I believe that this is a serious and practical problem for us teachers following Heidegger’s interested participant line of thought; perhaps especially so for those of us teaching in higher education institutions, as those we are teaching may be highly cognitive-reflective. And as for now, the point I am trying to make is only that your motivation when you enter a situation is important to understand. You have pre-conceptions, and if you are not interested in the particular practice, you should practice something else instead.

Arguing against the lecturer is part of the game for post-graduate students. You delve deeper. However, this is also the case with young students, for example those with a fixed mindset “I’m not one of those liking art”. I can’t carve. Or other reasons linked to their prior experiences, prior beliefs or preconceptions.

This could be bracketed as a pedagogical problem, which, in fact, it is; a real problem that needs to be addressed in every teaching situation. But if we listen to Heidegger (and Dewey and the like) it is more than that. It is a real problem, not only for their learning, but for their being-in-the-world. Their *dasein* is not there. They long for another place to be. How does this affect our teaching and even our possibility to use embodied making in education? And I could, if given time, take this further into questions like how this may affect the policy making and the respect for *our* research in society generally?

Staying within the topic of education, an open question in primary and lower/upper secondary school as in universities is this – how do we engage students? Do we force them to begin and hope they will fall for it as we have done? Is this possible to do in a generation brought up to ask “What’s in it for me”?

Teachers have several methods for engaging and motivating children. However, we could possibly add to those: methods for debiasing (Kagan) or facing up to pre-conceptions and intuitive understandings, and to find ways to remove expressive incentives for understanding something in one particular way, what makes it personal or evokes membership to a particular group or way of thinking.

Such techniques are mentioned as useful to adults, and as such perhaps most useful for those of us teaching at universities, but it would be interesting to develop a study on children and how they too are experiencing this.

In summary, if the focus should be on giving students time to experience, time to be-there, as practitioners in the practice - not necessarily to verbalize it either, just be dasein - What kind of lectures will this make for? And which concepts do we use to communicate this to the students? To principals, and the politicians?

Research



Figure 7 and 8: bowl in teak and flake metal. Ca 30 x 8 x 6 cm. Given to previous mother-in-law. Never seen again.

This line of questioning leads us forward to *research* on teaching and learning embodied making. A main problem in research on this theme is of course that the studied phenomenon is hard to access. Neurobiologists tend to trust computer generated images, even when the computer has been programmed by a human. With the obvious problems of self-confirming biases and the like, and of course this focus on electrons through neural imaging, on electrodes in the head of primates that

may or may not experience as we do, and the problem that neural imaging cannot document synapses or elusive chemical signals.

Educational research based on neuroscience in the 90'ies was flawed, Thompson & Nelson stated already in 2001. It used oversimplifications and misunderstandings, leading to quick fixes. However, the knowledge thus derived has progressed and new educational research based on genetic science and neuroscience has as well. As mentioned, this type of research confirms what we have known for a long time through observing behavior, analyzing, phenomenological research and so forth.

In my opinion, a viable step forwards today would be to find ways to combine methods and disciplines. Interdisciplinary studies using mixed methods both from humanities, social sciences and science. Recent studies which exemplify this include neuroscience knowledge, rigor/testing and human participants, behavioral, and philosophical/phenomenological studies.

The three special issues of the research journals *Studies in Material Thinking*; *Techne A*; and *FORMakademisk* after the Making-conference in 2012, features many interesting examples, some of which I have referred to in this text.

So, my questions to you are: Which research questions do you see? Which are feasible to study, yet relevant for the totality? Where should we prioritize our curiosity?

I for one would like to go further into motivation and engagement – what makes people resilient, what does it take for them to be open and jump into new things? How does embodied making stimulate resilience, making persons want to invest huge amounts of time to make something? My next study will be in here, I think, on craftsmen/volunteers doing living history/experimental archaeology. This can fit well under the scope of culture studies as well as education. But how it can be transformed to a feasible study, I still do not know.



Figure 9. Whittling winter wood.

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Studies in Material Thinking. 2013. Inside Making, Special issue to the Making Conference

<https://www.materialthinking.org/volumes/volume-09>

Techne A. 2013. Making, Materiality and Knowledge, Special issue to the Making Conference 20:3

<https://journals.hioa.no/index.php/techneA/issue/view/92/showToc>

Easy understandable but ok online resources to related topics:

Neuroscience:

http://www.cfa.harvard.edu/smg/Website/braincourse/brainlearning/unit1_sec1.html

http://www.huffingtonpost.com/2013/08/19/right-brain-left-brain-debunked_n_3762322.html

Motivation-cognition:

<http://www.nature.com/news/why-we-are-poles-apart-on-climate-change-1.11166>

<http://grist.org/politics/science-confirms-politics-wrecks-your-ability-to-do-math/>

<http://www.britannica.com.ezproxy.hit.no/EBchecked/topic/456811/philosophy>

Angela Lee Duckworth in a very short TED video on mindset and grit:

http://www.ted.com/talks/angela_lee_duckworth_the_key_to_success_grit.html

Carol Dweck video on Mindset <http://www.youtube.com/watch?v=eGnqgXmITk4>

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