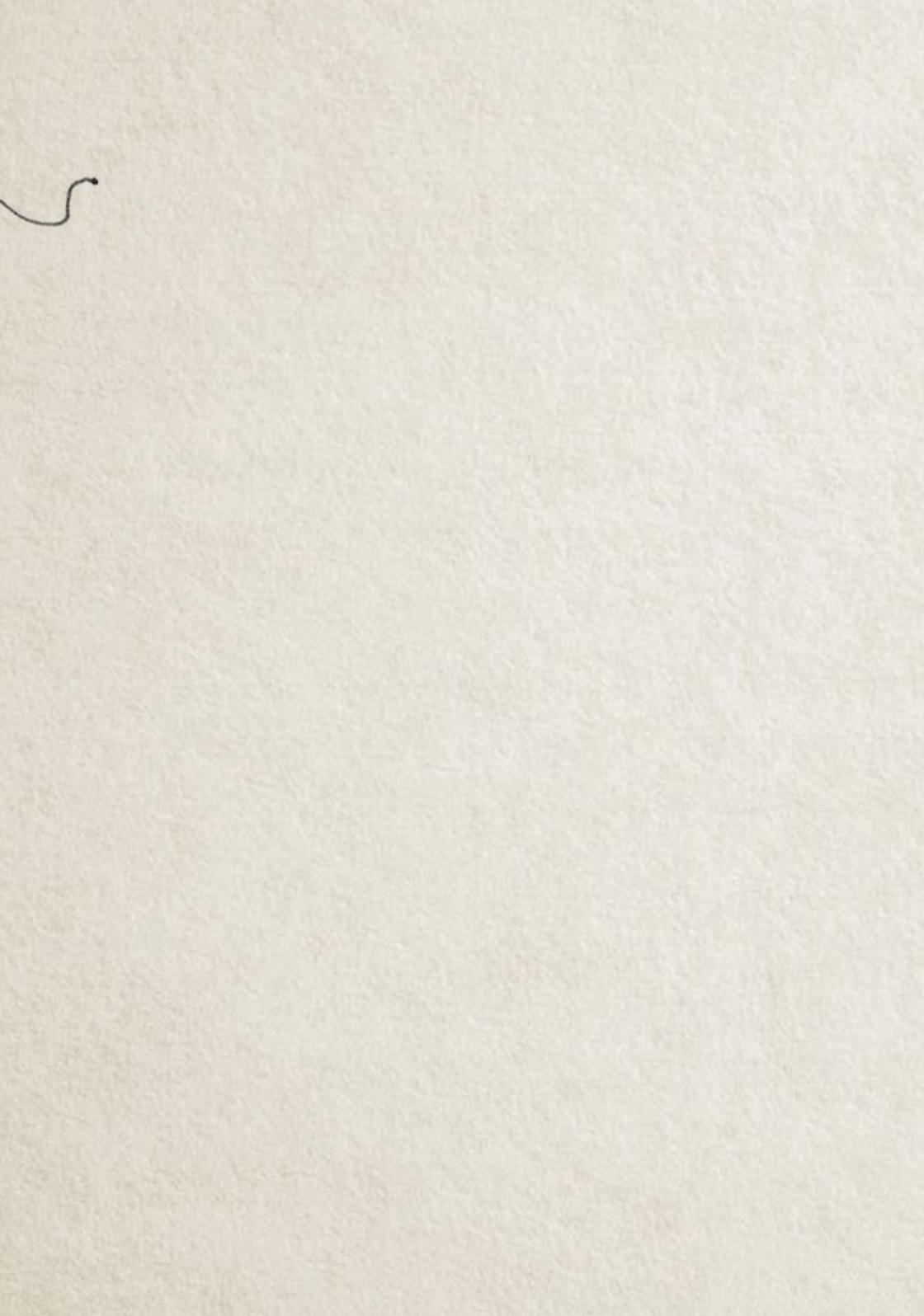


Drawing to learn



Encouraging the explorative and dialogic potential
of sketching in design education



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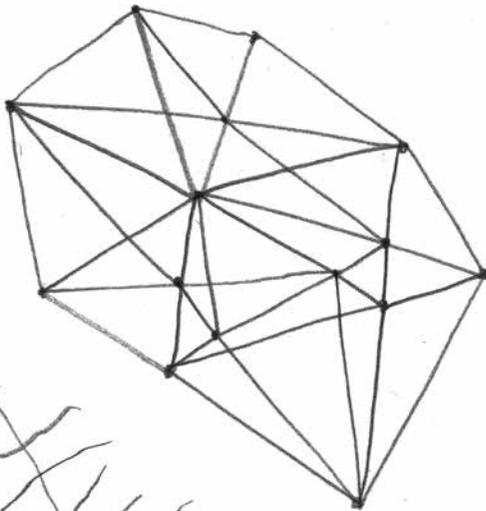
Encouraging the explorative
and dialogic potential of
sketching in design education

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Graduation Thesis and Educational Project
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Supervisors Renee Turner | Sjoerd Westbroek. Exterternal critic Klaas Hoek

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Preface

How is it that you can learn from an image that you have made yourself? This simple question is at the foundation of the long fascination I have had with drawing. I came into product design education nine years ago as a drawing teacher with a background in art. Over this period, I had the pleasure to assist many students as they learned to use drawing to explore, develop and communicate spatial ideas on paper. Teaching in this context has given me a deep appreciation of the value, and functional necessity, of drawing in product design and engineering. After nine years of teaching, a period of study allowed me to take a broader view on the practice of drawing and pedagogy again. An inspiring field of critical educational theory helped me to explore the potential of a more emancipatory learning experience. A central motivation was to better understand the some of the tensions in my own educational practice between skill development and the critical, creative autonomy of students.

As a participant researcher in my own teaching practice I do not make a claim to objectivity. I write about practice and theory in a personal, reflective and narrative style. In my writing and drawing I tried to take on some of the advice I give to students when it comes to creative questions, namely to explore alternatives and to go beyond making work 'about' things and attempt to embody and perform your message.

Following a part-time study alongside a teaching practice has been challenging and rewarding. My study peers and the lecturers at the Piet Zwart Academy have been an inspiration. Sharing this process with them helped give me the energy and motivation I needed for so many weekends of study.

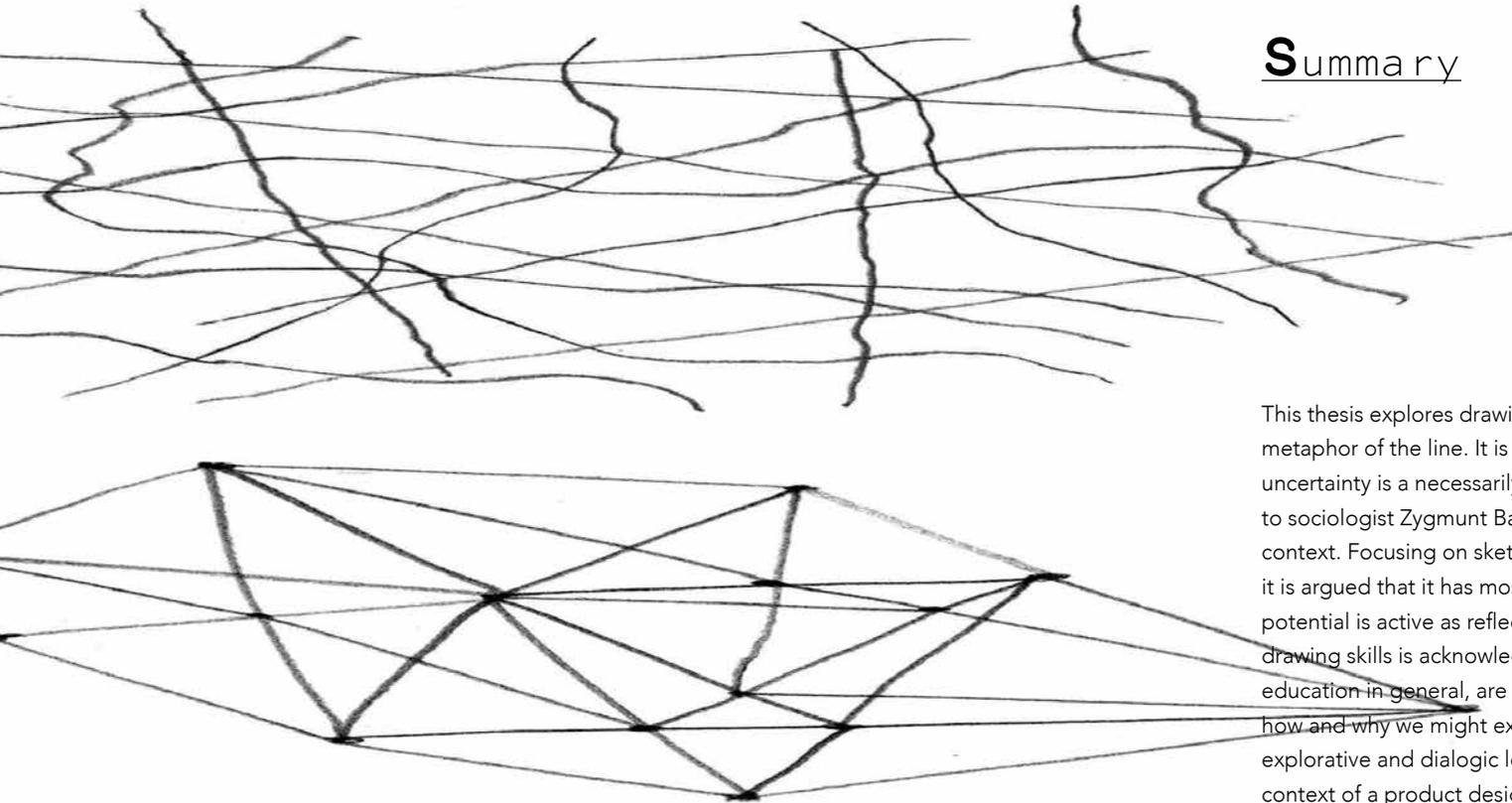
At my place of work, the Amsterdam University of Sciences, many insightful conversations took place with teacher colleagues, in planned meetings and unplanned moments between lessons. I would like to thank them for their patience in tolerating yet another conversation (or rant) about drawing, pedagogy and self-directed learning. Thanks to my colleague drawing teachers, the coordinators of projects and subjects who were open to extending the role of drawing and Jan Siebers the department coordinator who allowed me to invest time into this study with the support of the Amsterdam University of Sciences.

My graduation supervisors Renee Turner and Sjoerd Westbroek both gave insightful feedback and encouraged my writing and drawing experiments. Klaas Hoek; my external critic's experience, dedication and sensitivity as an artist and teacher was palpable in our meetings and made our conversations so rewarding.

To my partner Tytis Sonnenfeld, thank you for being as supportive as always and helping with the final layout in InDesign a day before the deadline.

Finally, I would like to thank all the students who participated and dared to explore 'other' ways of drawing.

Sebastian Schneiders
11.06.2017



Summary

This thesis explores drawing practices in product design education using the metaphor of the line. It is suggested that coming to terms with complexity and uncertainty is a necessarily dialogic and explorative process. With reference to sociologist Zygmunt Bauman, education is situated in a 'liquid modern' context. Focusing on sketching as an indeterminate and questioning practice, it is argued that it has most value to design practices when its dialogic potential is active as reflection-in-action. While the need for conventional drawing skills is acknowledged, purely instrumental definitions of practice, and education in general, are critiqued. An integrated educational project explores how and why we might extend drawing education in design to encourage explorative and dialogic learning. The educational project takes place in the context of a product design curriculum that is in a process integration into a broad engineering degree. Research takes place in my own teaching practice as participant research. Practice and theory are woven together in a personal and reflective thesis.

An inquiry into lines as they relate to drawing and learning, comes to function as a metaphor throughout the thesis. The decisive straight (learning) line is contrasted with lines that hesitate, deviate and meander. The work of anthropologist Tim Ingold is guiding. It is argued that while developing manual dexterity in drawing is important to product design and engineering practice, education should also expand beyond the routines of skill training to encourage explorative and dialogic learning. Drawing *as* learning; as noticing, communicating and refining sensitivities. It is suggested that drawing education, with a focus on sketching, might then evoke learning experiences that encourage some of the abiding attitudes and incentives most relevant to design practices.

INTRODUCTION

If we are to understand the nature of engineering, we must appreciate this important although unnoticed mode of thought. It has been non-verbal thinking by and large that has fixed the outlines and filled in the details of our material surroundings...Pyramids, cathedrals, and rockets exist not because of geometry, theory of structures or thermodynamics, but because they were first a picture – literally a vision – in the minds of those who built them (Fergusson, 1977, p.853. Cited in Latour, p.3. 2011).

Throughout the history of art and design the practice of drawing has served as a way to explore, test and communicate visual and spatial concepts. In particular, the sketch has been valued for an indeterminacy that allows multiple design paths to stay open for reinterpretations, adjustments and new insights. This unfinished quality positions the sketch in a discursive and generative mode, a mode of visual research rather than just an end-station. Creative ideas emerge during reflective cycles of exploration, speculation and dialogue. They are not designed in the head and then skilfully projected, fully articulated, onto a page.

More than just drawing skill what is at stake in design education is whether a student's drawing practice becomes embedded in attitudes and motivations suitable to the explorative and dialogic nature of creative practices. I suggest that learning conditions should encourage students to negotiate levels of complexity and ambiguity so that a range of methods are explored and developed in personal and meaningful ways. Referring to Donald Schön's concept of 'reflection in action' and the 'back-talk' of sketches (which entails a critique of instrumental rationalism) I suggest that drawing education should extend beyond just skill training (methods) and give attention to the incentives, attitudes and values evoked in the educational situation. Bruno Latour writes that "perspective drawing is not interesting because it creates realistic pictures;...it is interesting because it creates complete hybrids: nature seen as fiction, and fiction seen as nature, with all the elements made so homogeneous in space that it is now possible to reshuffle them like a deck

of cards" (Latour, 2011, p.9). It's clear that perspective drawing is a powerful representational system that homogenizes space, nature, fiction and vision to control it. However, when designing, the power to act on the world comes from both fixing and unfixing, not just describing but also doing things with objects and materials. A sketch's value is that it is mobile, immutable and mutable. Mutable, in so much as it is propositional and suggestive rather than definite. It's when drawing is used to explore a range of possibilities that it triggers lines of questioning, active doubting and reflective cycles of framing and re-framing (definitions, methods and purposes). This is an exploration into possibilities, a dialogic process of individual and mutual speculation. Teaching drawing for this purpose requires learning situations that challenge students to explore and reflect with their drawings. Here, drawing's purpose is not to persuade but rather to inhabit a problem space, provoke alternatives and evoke possibilities.

Alongside the necessity of drawing skills in design education is the potential for drawing as learning; as noticing, exploring, sharing and developing sensitivity. Drawing education in design might then evoke valuable experiences that encourage long-term motivations and attitudes relevant to practice. The current educational context however, is impatient and is often focused on short-term goals and tangible, measurable outcomes. This context seems to favour more straightforward training. Students in product design and engineering also often prefer to be taught well-defined skills in a simple and direct way. This project explored the educational value of diverging from these straight and clearly defined paths to create learning situations that encourage the explorative and dialogic behaviours that can open paths towards more reflexive visual practices and that put drawing to work as learning.

POSITION AND METHOD

Learning with

'Liquid modern' is a society in which the conditions under which its members act change faster than it takes the ways of acting to consolidate into habits and routines...Liquid life...cannot keep its shape or stay on course for long (Bauman, 2005, p.1).

Initially I conceptualized the practice-based part of this thesis, the education project, as a series of interventions. However, this concept is problematic in my situation. An intervention implies a clear distinction between separate entities. It suggests an intervening agent disrupting or changing the course of a predetermined trajectory. But what if the current state is already in flux? What if its trajectory is uncertain, its composition porous and unstable? If, as Zygmunt Bauman has argued, we live in times characterized by constant and unpredictable change (2005), perhaps all we can do is add our own trajectories to the mix in the hope that collectively these paths will coalesce and help give shape to a (more) hospitable future. Working in a school as it undergoes a major restructuring has opened the field for a reevaluation of the role of drawing in a technical design study. The discontinuation of "design-drawing" as a stand-alone subject has created new challenges but also opportunities. In this situation characterized by a concerted effort on the part of the institution towards an integrated curriculum, reporting on

single instance of practice seems inappropriate. Within the study drawing occurs in a wide range of range of situations, in pre-structured assignments, in personal student sketchbooks, in technical assignments, brainstorm sessions, for presentations, during coaching sessions, on paper, digitally and in 3D modelling programs, to name just a few instances. When project coordinators require a drawing component I offer suggestions. This involves a negotiation with a range of stakeholders, including schedule planners, year coordinators and other drawing teachers. The scope, timing and focus of the drawing component in a course is decided in collaboration. Sometimes I have very little influence on the form and scope of the drawing component and sometimes more, this positions my educational research in a dynamic institutional and interpersonal reality. In a changing situation, we can retreat into the (false) security of well-known routines or embrace the risk of exploration, dialogue and transformation. This project involved a conscious effort to explore a number of detours from the standard routines of design drawing instruction in an effort to reveal insights useful to the drawing education in design-engineering.

As a researcher in my own practice there can be no 'distancing' or purely objective perspective. Hennie Boeije describes the role of a participant researcher as operating on a continuum between participation at one end of the spectrum and observation at the other (Boeije, 2010, p. 61). As a teacher, I am completely embedded in practice, my observations occur from the inside, field notes consolidate observations and offer a space to reflect on practice. Indeed, perhaps it's only the reflective attention on my part that frames my continuing educational practice and qualifies a part of it as a research project.

My first effort to report on practice was an attempt to describe in neutral language a collaborative drawing session in a first-year design project. For the purpose of generating research data I had videoed the lesson with a camera positioned in the corner of the classroom. A report of this workshop was predominately an exercise in description, memos expanded on observations as an initial effort to draw out themes. However, while reviewing and writing up what I saw in the video footage I realized that recording students immersed in the act of drawing did not offer the insights into the educational experience I had hoped for. While pausing video frames to look for salient segments, as an initial attempt at coding, I realized that these images revealed only the surface of what had occurred during the lesson.

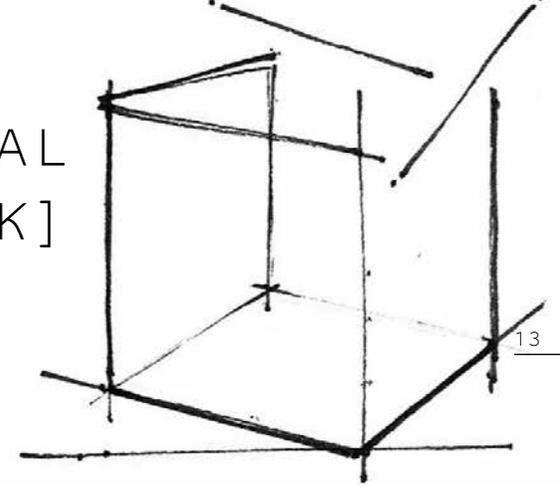
Video footage offered a view from the outside that was incongruent with the essence of my project. This begged the question, how could I report on my research so that it would generate insights and reflections 'from the inside' with students, teacher colleagues, and study peers and with reading, writing, teaching and drawing?

In *Making: Anthropology, archaeology, art and architecture* Tim Ingold (2013) makes an appeal for a mode of participant research, based in the anthropological tradition, whose central objective is not just to describe and account for its subject of inquiry but to transform, and to be transformed by, *learning with* the subjects, situations and materials of a research process. In contrast to learning *about* or learning *from* "learning *with*" is an effort to attend to the task of giving shape to a shared future. Describing the importance of participant research in anthropology he writes;

For participant observation is absolutely not a technique of data collection. Quite the contrary, it is enshrined in an ontological commitment that renders the very idea of data collection unthinkable. This commitment, by no means confined to anthropology, lies in the recognition that we owe our very being to the world we seek to know. In a nutshell participant observation is a way of knowing from the inside (Ingold, 2013, p.5).

Learning *with* people, materials and situations, as opposed to learning *about* them is to take part in a continuing reflective engagement with the world. These theoretical and methodological concerns wove theory and practice through my daily experience as a teacher and this thesis is a trace of this reflective engagement.

THEORETICAL [FRAMEWORK]



Sketching

In design practices solutions emerge through a negotiation of a range of dynamic and interrelating forces (social, cultural, psychological, haptic, tactile, material, etc.). Meanings are negotiated with these forces and decisions are made in diverse teams of stakeholders. An essential competency in design practices is therefore the ability to work through ambiguous problems in the various complex and overlapping fields coinciding around design challenges. Purposes for drawing in design professions are diverse. In the field of industrial product design while various 'types' of drawing can be recognized by their distinct aesthetic qualities, they are commonly defined by purpose rather than formal qualities. Four commonly defined types of drawing are; (1) idea generation and exploration with *ideation sketches*, (2) convincing stakeholders with *persuasive drawings/renderings*, (3) clarifying relevant aspects of a design with unambiguous *explanatory drawings* and (4) specifying technical details with *prescriptive drawings* (Self, 2016). Having different purposes, each type of drawing demands its own distinct set of competencies. Of these four types of drawing, the "ideation sketch" or "exploratory sketch" is certainly the most difficult to pin down to a simple set of representational conventions and skills. This is because when drawing is used to research and explore alternatives, thinking and drawing practices are necessarily intimately interwoven. Here, the act of drawing is not in the service of vision alone. Embodied acts of mark making and reflection generate drawings together in a process that could be described as a form of creative praxis. Ideation cycles can be instigated at any stage in a design process.

Designers will generate tentative solutions, but also leave many options open for as long as possible, they are prepared to regard solution concepts as temporarily imprecise and often inconclusive (Cross, 2011, p.12).

It's in this tentative and explorative sense that sketching (and sketches) help designers think through complex design challenges. For many designers and engineers sketching is a necessary extension of language. A pen or pencil must be ready at hand to compensate for the limits of spoken or written language, without an image many design conversations are simply not possible. This spatial-action-language (Schön, 1991) facilitates communication between various stakeholders but perhaps the most fundamental learning comes from the 'dialogic spark' that is triggered when a drawer tries to give form to his own thoughts with marks on paper. The act of drawing evokes a reflective and dialogic process in itself. Simply trying to articulate ideas visually reveals gaps and evokes previously unconsidered opportunities. Drawing is therefore not simply a way to represent ideas but a generative agent in the explorative and dialogic learning central to design practices. Through drawing our ideas are visualized and our bodies become complicit in bringing things into the world. Hand/eye coordination, but also hand/mind coordination are important. Architect Juhani Pallasmaa (2009) suggests that these haptic and material dimensions in drawing practice connect design thinking to tacit and embodied dimensions of experience. By tracing our thoughts with marks on paper, these traces to build up in layers, traces of gestures made in time come to exist simultaneously as a field of ideas. A page of sketches is no longer determined by the chronologic logic that produced it. Sketching helps reflection traverse time.

The drawn image contains the experience of looking. A photograph is evidence of an encounter between event and photographer. A drawing slowly questions an event's appearance and in so doing reminds us that appearances are always a construction with a history...A photograph is static because it has stopped time. A drawing or painting is static because it encompasses time (Berger, 2005, p.43).

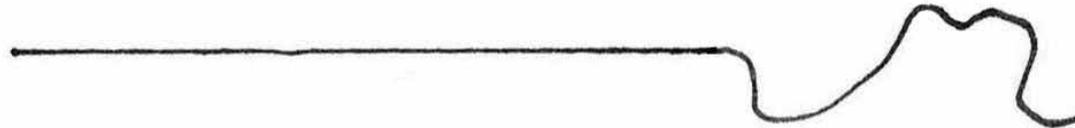
The value of this for designers is that it allows connections to be perceived that are difficult to imagine with memory. As layers of thought and action accumulate in sketched ideation pages, producing a chronology of ideas,

these visualizations become simultaneous on a field that carries the accumulated traces of thoughts and actions. As long as this field maintains its unfinished status it is potentially a dialogic space.

As preliminary research, I conducted an interview with two engineering teachers. Both are passionate teachers with a professional engineering careers. I hoped to gain a deeper understanding into the current perspectives among engineering teachers about the role of drawing in design-engineering education. Both teachers explained that foundation-year student's reluctance to sketch seriously limited teacher/student dialogues about spatial design problems. For these engineering-teachers sketching was simply a necessary part of an engineer's vocabulary. They explained that drawing was important because the process of attempting to articulate spatial concepts in a graphic space often revealed important gaps in thinking and revealed previously unconsidered opportunities. They complained that when novice engineers and students began the design process digitally, design decisions were often nothing more than the consequence of standard software operations. Important decisions were made without reflection or purpose.

The descriptive value of drawing but also the value of drawing to learning was important to them. Drawing gave a focus and purpose to student thinking that was easily obscured by the automations of software. Telling was that during the interview both engineers drew simple low-fidelity sketches to support their verbal explanations. As they spoke about questioning students during coaching sessions they both drew to explain what they meant. How are parts joined? How do the radii on edges join at corners? How thick is a material? Is a material rolled at its edge like a disposable paper cup or is it just bent? These simple thumbnail sketches were not made to be kept. They were only relevant during the interview and yet they were essential to a discussion about spatial questions. Listening to the recording of the interview afterwards it was clear that the audio recording did not contain everything that had been said, more than half of the conversation had occurred on paper.

While I put my pen on paper I still don't yet know how it is constructed, that's how I work then...I discover the solution while I'm drawing. You let the pen think for you, that's how it should be (Appendix B - my translation).



Donald Schön (1991) offers an insightful description of this half-speaking, half-drawing language in *The reflective practitioner*. Architect-teacher 'Quist' and student 'Petra' are discussing Petra's design of an elementary school during a design review. The conversation is not only verbal, drawings are made during the conversation to explore strategies and try out spatial design moves.

The verbal and non-verbal dimensions are closely connected. Quist's lines are unclear in their reference except insofar as he says what they mean. His words are obscure except insofar as Petra can connect them with the lines of the drawing. His talk is full of dychotic utterances - "here", "this", "that"- which Petra can interpret only by observing his movements (Schön, 1991, p. 81).

Engineers, product designers, industrial designers and architects are notoriously quick to grab a pen or pencil in conversations concerned with spatial issues. Sketching offers a direct way to articulate and try out explorative moves during the process of designing. Even before sharing drawings with others the very act of externalising tentative solutions and fixing them in graphic space can instigate a process of explorative and dialogic learning.

Drawing and talking are parallel ways of designing, and together make up what I will call the language of designing" (Schön, 1991, p.80).

In Quist and Petra's dialogue sketching facilitates the mutual exploration and analysis of a spatial design challenge. Sketching offers a way into the visual and spatial dimensions and facilitates the explorative moves necessary to finding a path forwards. Petra is having trouble integrating a series of classroom modules into a "difficult sloped site". Drawing on transparent paper over Petra's sketches Quist demonstrates how she might tackle this problem by re-framing it. He suggests that she impose an 'ordering principle' to work with which can be 'broken open' later on (Schön, 1991, p. 93). Sketching is part of the design 'language' that allows the teacher and student to inhabit and model the space in which design thought and action occurs. Importantly, these sketches also produce unintended insights, what Schön terms "back-talk".

The notion of back-talk is central to his critique of a tendency to instrumentalize professional processes. He argues that because solutions emerge in complex

and unpredictable situations professionals cannot just routinely perform tasks but must "reflect-in-action". The conversation between the teacher 'Quist' and the student 'Petra' demonstrates how ideas and opportunities arise out of an active and reflective inquiry. The sketches that Quist does while responding to Petra's design problem facilitate their discoveries and suggest a way forward. The drawings function as provisional, mutable, graphic objects to think with. Dennis Scott Brown talking about architect Robert Venturi's, conversations with drawings, remarks;

Sometimes the hand does something that the eye then re-interprets and gets an idea from and that kind of drawing for yourself and a few other people around the table is Bob's [Venturi] great speciality and those drawings have a nervousness to them and a tension, some of them are just wonderful but they are never done as a work of art, they are done as a communication with self and with people around the table (cited in Lawson and Dorst, 2009, p. 47).

Quist and Petra's conversation begins with an open inquiry where the teacher tries to understand the student's difficulties with the design challenge. The teachers design expertise is revealed in the way he strategically reframes the challenge which allows an alternative design path to emerge. By sharing strategies, he teaches the art of designing. This teaching and learning occur in the spatial-action-language facilitated by drawing. What is being taught and learned it is not a routine method. Expertize is shared by thinking aloud with working through a problem together, the student is guided through a complex design problem. The teacher anticipates creative dead ends, reframes problems and suggests alternative approaches that strategically solve the most salient questions at the right moment. It's the interaction between the sketches (artefacts), the sketching (process) and the reflective conversations around them that facilitate a deeper mutual understanding of the problem/solution space and lead to a solution.

Learning from sketches is based largely on the ambiguous nature of their representations. That is, they do not specify everything and lend themselves to, and encourage, various interpretations that were not consciously integrated into them by their creator (Buxton, 2007, p. 118)

Explorative moves

During conceptual explorative stages expert designers consciously keep diverse research paths open and allow for multiple interpretations. They make explorative moves in order to gain an understanding of the problem space, and to iterate dialogically towards a solution. Research into design expertise suggests that a tolerance to ambiguity is common to expert designers across a wide range of design professions (Cross, 2011) (Lawson and Dorst, 2009). To discover new design paths, designers also need to challenge their own unconscious preconceptions. Keeping divergent design paths open allows for new patterns and insights to emerge. A conscious effort towards pattern breaking is therefore essential. Divergent thinking, expansion, heterogeneity, critical reflection and complexity are fundamental to creativity and innovation. Sketching can function as a reflexive visual language that makes 'explorative' and 'move testing' experiments, facilitating the process to learn our way towards a solution (Schon, 1991, p. 147). Sketches are temporary descriptions, they are dialogic in the sense that they are tentative rather than resolute and have the potential to reveal more than was consciously intended. They operate to question and suggest possible paths of action. Sketching for this purpose can help sensitize a designer to the complexities and emergent opportunities of a design challenge.

one of the key purposes of sketching in the ideation phase of the design process is to provide a catalyst to stimulate new and different interpretations. Hence sketching is fundamental to the cognitive process of design, and it is manifest through a kind of conversation between the designer(s) and their sketches (Buxton, 2007, p.116).

'New Beginnings and Monstrous Births: Notes towards an appreciation of ideational drawing' (Rosenberg, 2008) focuses on ideational drawing in industrial design practices. By defining this type of drawing as a "thinking space" as opposed to a space where ideas are "re-presented" the essay creates some useful distinctions that help to sharpen our focus on some of the more elusive qualities relevant to the act of drawing, and more specifically the thinking in drawing that attempts to help us move from the known into the unknown. In ideational drawing the "conjectural-hand" is not limited to just apprehending the world, it can also "disturb, dislodge, carry and

connect" it can also produce "other arrangements for thinking". It can be used as a critical creative questioning that produces an agitation in what is given. It works to overthrow the tyranny of what is given" (Rosenberg, 2008 p.112). Ideational drawing is here "pre-notional", a kind of thinking that, through drawing, generates new thoughts and actions. The drawing hand is accredited with the ability to redirect thinking towards "that which withdraws from thought" (Rosenberg, 2008, p.110). In the explorative cycles of a design process it is therefore not fidelity or accuracy that determines a drawing's quality but rather a drawing's capacity to generate meaningful opportunities for new interpretations and design moves. When the goal of drawing is to explore a range of possible design paths, purposefully reduced definition allows a designer to focus on key elements. When a drawing has an appropriate level of fidelity for the questions at hand it's dialogic function is emphasised (Buxton, 2007).

These explorative moves require more than unconstrained divergent thinking. Beyond initial divergent brainstorming exploration needs to be directed by reflection, in order to distinguish experimenting in practice from a research context. Donald Schön suggests that the interest in both understanding *and* transforming a situation is the key difference between research and practice. He distinguishes three types of experiments; exploratory experiments, move-making experiments and hypothesis testing experiments. He suggests that when a practitioner reflects-in-action he combines all three approaches to understand and transform a unique situation. An exploratory experiment is any action that is taken to discover the qualities of materials or situations without predictions. It is an open-ended inquiry into an unknown terrain, a way of probing a situation or material to see how it will respond. A move-testing experiment, in contrast, is an experiment with an end in mind. It is used to find out if a predefined goal might be achieved with a particular action, the result of which might be affirmed or negated, and/or produce unintended outcomes. Finally, hypothesis testing is a kind of reasoning whereby competing hypotheses are tested, leaving the hypothesis best able to resist refutation as truth until a better hypothesis is discovered (Schön, 1991, p.146).

More recently design theorists have argued that, unlike scientific reasoning design reasoning is guided by outcomes conceived, not in terms of generalizable truths and theories, but rather in terms of (aspired) values to

be actualized with specific products or services. They suggest that the kind of reasoning used by designers to deal with open and complex problems is not deductive or inductive but rather 'abductive' (Cross, 2011, Dorst, 2011). The designer must discover the 'what' and 'how' that will assist producing the desired value.

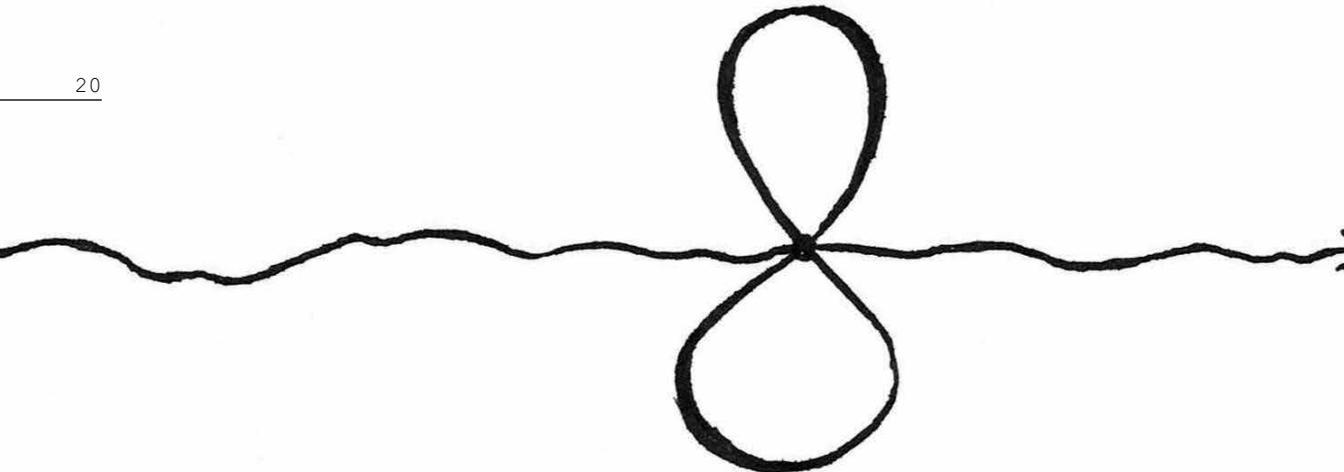
Performing the complex creative feat of the parallel creation of a thing (object, service, system) and its way of working is the core challenge of design reasoning. This double creative step requires designers to come up with proposals for the 'what' and the 'how', and test them in conjunction (Dorst, 2011, p.525).

Designers and artists that operate in three-dimensions need sketches to engage in a meaningful way with spatial questions. Here, sketching operates in anticipation, between language and material, and in the ambiguous space where only a desired value is known. In a situation where both methods and solutions are uncertain the act of visualizing ideas can produce graphic objects to think with. The action and reflection in and around drawing is a form of learning, this learning comes from the 'back-talk' of sketches which reveal opportunities or gaps in thinking (Schon, 1991, p. 79). An important part in the practice of drawing for design is therefore found in the dialogic action and reflection in and around acts of drawing.

Dialogic reflection

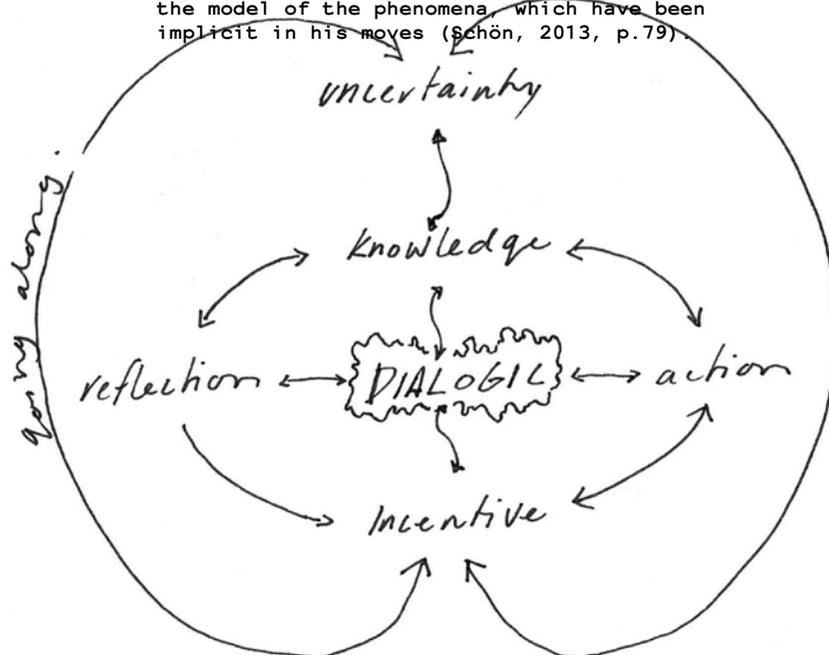
Towards the end of the 20th century the social scientist Donald Schön (1991) argued that the drive to professionalize a wide range of work practices had led to a "Positivist epistemology of practice" and that "technological rationalism" could not help us understand the complexity of contemporary professional practices. His in-depth study of the situated practices of an architect-teacher, a psychotherapist, a town planner and a manager in *The reflective practitioner* (Schön, 1991) convincingly showed that professional practices depend on experiential knowledge that is inherently situational and difficult to quantify. Complex and changing situations require that professionals anticipate consequences with refined sensitivities to the particularities of each new situation. Schön called this reflective conversation with the situation 'reflection-in-action'. Education that prepares students for the unpredictable nature of professional practices requires learning situations that foster the kind of reflection and action suited to engaging with as-yet unstructured complexities;

Design can be seen as a process of learning; as a designer, you gradually gather knowledge about the nature of the design problem and the best routes to take towards a design solution. You do this by trying out different ways of looking at a problem, and experimenting with various solution directions. You propose, experiment, and learn from the results, until you arrive at a satisfactory result. For instance, when you are designing, you sketch an idea and then look at what you have made with a critical eye. This fresh look immediately shows you what needs changing to improve the design. So, you modify and then you look again critically at what you have done. Design can be described as a process of going through many of these 'learning cycles' (propose-experiment-learn) until you have created a solution to the design problem. In this way, you explore different possibilities and learn your way towards a solution (Lawson and Dorst, 2009, p.34).



Designing involves exploring tentative solutions and then reflecting on their implications in an effort to anticipate emerging potential. Sketches, wire-frames, models, prototypes etc. generate feedback that help to understand a problem space and help make decisions. Explorative 'moves' are made to help navigate a path towards a desirable outcome. When drawing serves this explorative purpose, it facilitates what Schön (1991) termed a "reflective conversation with the situation". Explorative design sketches, whether they are digital 3D models, material models, or drawn on paper are images to think with. In fact, a sketch might be defined as anything that is made to anticipate, suggest and open possible design paths. Noticing and negotiating emerging constraints and affordances in a design process entails a conversation with the situation. Thinking and action should respond with sensitivity and intelligence to complex problems and take advantage of opportunities as they arise. Sketching on paper, with digital tools or with sketch models allows designers to activate visual dialogues. These dialogues are both personal and interpersonal, with both present and anticipated situations and with the tools, methods and material used to explore the design challenge.

In a good process of design, this conversation with the situation is reflective. In answer to the situation's back-talk, the designer reflects-in-action on the construction of the problem, the strategies of action, or the model of the phenomena, which have been implicit in his moves (Schön, 2013, p.79)



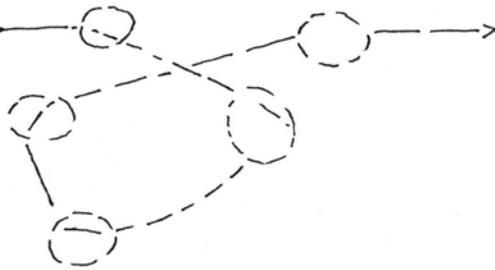
What is a line?

In his meditation on the meaning of lines Anthropologist Tim Ingold (2007) describes a taxonomy with a number of distinct categories. In the first category are threads, these are linear filaments that can hang between fixed points like spider's webs, reach outward like mycelium or/and can be woven together with other threads to make surfaces. In the second category are traces; traces can appear by addition or by subtraction, when a substance like ink or chalk is used to draw it is added to a surface leaving a trace. When material is removed from a surface, like a scratched line on an etching plate a line is created by subtraction. A further category includes cracks, cuts, and creases and yet another "ghostly lines" such as the imagined lines between the stars that make constellations.

The first lines that children draw are not representations. These lines simply explore the affordances and limits of the child's body (Kovats et al., 2007, p. 08). They are traces, indexical tracks of movement. Only with the advent of language do we discover motivated lines, lines made with the intention to tell. It's fascinating to watch young children begin to draw. As motoric control and language skills increase, drawing becomes a signifying practice. A circular motion makes a round line, a circle, a head, two more small circles make eyes, a line curved upwards makes a smiling mouth, the nose is made of three lines, a triangle. Hairs are already lines, lots of them. These lines describing a face are signifying lines. The lines you are reading signify also. In semiotic terms a written letter is a grapheme, these line configurations need to be learned before we will recognize their culturally determined meanings. Conventional signifiers make dialogue possible. Do you remember learning to draw the lines that make letters, practicing rows of a's and b's or learning to write your name? My mother kept some of my early attempts, the ones with the backwards S's. The word LINE (in capitals) is made of five vertical lines, four horizontal lines and one diagonal line. This complex construction signifies — strangely it doesn't seem to work the other way around "—" doesn't mean line. It is a line but doesn't mean it.



Learning to draw and drawing to learn



In her extensive trans-historical study *The Primacy of Drawing*, Deanna Pentherbridge (2014) suggests that “however contradictory in their specifics” throughout the history European art theories of drawing;

all share the view that drawing is many stranded and comprises at least some of the following elements: it is essential to the conceiving of ideas; it initiates the work of art; it is a part of the developmental process of making; and it is implicated in the end product whatever the medium. In other words, drawing is a part of a continuum of making and thinking and of invention and completion (Pentherbridge, 2014, p.18).

Sketching in perspective allows explorative spatial thinking to take place in a virtual 3-dimensional space on a flat and mobile surface. Lines (virtually) break through the picture plane allowing them to shape and reconfigure virtual spatial objects. This kind of spatial drawing powerfully facilitates thinking about spatial problems. Most drawings in design-engineering are made in anticipation of forms to be made in the future. A sketch, however, is more than this. When we sketch, we do not just articulate mental images but grow them from multiple layers of marks and gestures. Sketching invites us to respond to the forms emerging on our page, or screen, as potential. Sketches are in this sense graphics to think with, they are spatial ideas that we manipulate and reconfigure as they emerge. Learning to draw in perspective involves learning to apply conventional knowledge and skills. The illusion of a consistent three-dimensional space depends on following the rules of linear perspective. Perspective drawing gives design students a ‘spatial language’ with which to manipulate three-dimensional form on paper. As a representational system, it’s rules are well defined. Becoming skilful in its use

depends on learning to apply these rules consistently. The key to breaking through the picture plane into a virtual three-dimensional space is the vanishing point. Following a few simple geometric principles, students can begin to think of drawing in terms of volumes. Similarly, while light conditions can vary enormously, light behaves consistently, again a simple set of rules can facilitate a steep learning curve. Accepting that these conventions are valued in product design and engineering, and that we can’t expect students to discover the rules of linear perspective and light on their own. A task of teaching drawing in this context is given to transferring some of the accumulated knowledge of practice from expert teachers to novice students. Put simply students need to learn to draw in perspective. The didactic and pedagogic challenge then, is to set a path with the potential to expand from these foundational perspective drawing skills (learning to draw) towards a critical, reflexive and creative practice of “drawing to learn”. Drawing to learn is dependent on the active construction, deconstruction and reconstruction of methods and possibilities. Aside from drawing skill, also incentive, sensitivity, creative courage and openness to other perspectives are important to developing a drawing practice that can operate as a dialogic spatial language. If inquiring, motivated and sensitive attitudes are to emerge they depend on learning environments that encourage them. As a ‘spatial-action-language’ drawing will need to be practiced in the context of reflective visual ‘conversations’. To learn *with* drawing a level of fluency in drawing is needed, but this must be a fluency that supports a nuanced reflexive practice and has the critical faculty to be able to use, but also to see and act beyond just standard routines.

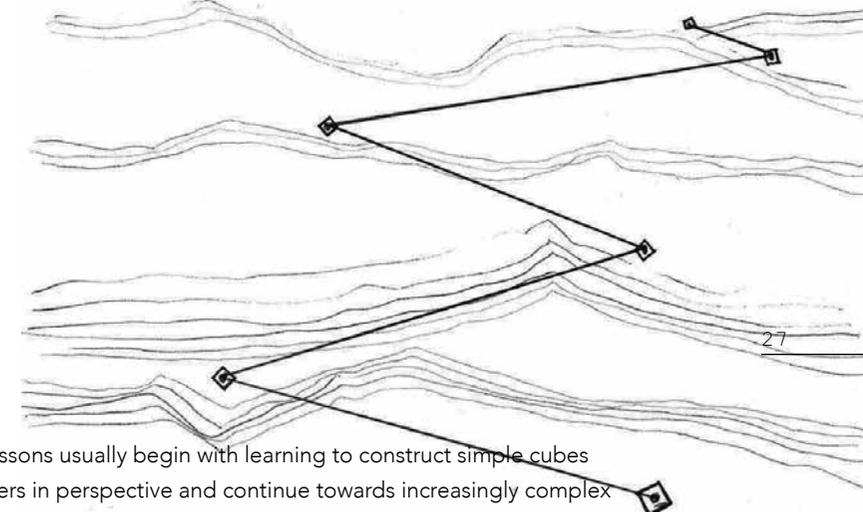
In my teaching practice, I’ve found its often useful to take some time to demystify drawing ability so that students understand that perspective drawing is something that they too can practice and learn to do. Without this initial encouragement students may give up before even trying simply because of their stubborn conviction that they cannot, and never will be able to, draw. I often remind students that handwriting is also drawing and that if they have the enough motoric control to draw letters that they will certainly be able to draw other kinds of pictures. However, it is precisely here that a stubborn misconception about drawing practice often appears. If drawing is only taught as a skill for accurate representation it can lead to an uncritical teleology that undermines its potential as a process of learning. When the success or failure of a drawing is only judged on its measure of finish,

learning stops once heuristic routines and training have been sufficiently mastered. When the purpose of drawing is to create graphic objects to think with, over-definition is counter to our purposes. A drawing of a spatial 'idea' needs to create a two-way link with an absent object, an idea, or system but this image also needs to be open enough to be unfixed, propositional, suggestive and malleable. The challenge then is to help students develop skills they need for the articulation spatial concepts without losing sight of their drawing's explorative and dialogic purpose as sketching. We might then ask when and to what degree should a line be made routinely?

One entry point into this question is to consider how drawn lines operate in a three-dimensional graphic space. A two-dimensional drawing is made of lines that are simply traces on surfaces. They operate in the world of 'real' objects and materials on the picture plane. The line on a flat graphic space has no obligations, it can ignore any grid and go where it pleases. The lines in a perspective drawing, however, must operate within the rules of a constructed virtual space. They must work to maintain a whole system that ensures the illusion of depth on a flat surface. A deviant line can potentially collapse the whole system. Put to work, the line in perspective is given a task (by the planes and volumes it serves) to define their edges and surfaces. Visible and invisible lines serve vanishing points that, for the maintenance of virtual three-dimensional space, demand that all lines operate in accordance with their constructed linear system. In a perspective drawing the line defines but also serves the volume.

In the western art canon, linear perspective was the dominant visual convention from the Renaissance up until the late 20th century. Most art academies taught the principles of perspective drawing, anatomy and lighting in strict drawing ateliers. These regimes in the drawing ateliers of gave rise to challenges that Dianna Pentherbridge (2010) suggests continued as a defining narrative of western avant-garde art.

Engineering is an industry that puts a great deal of effort into creating norms and standards to reduce the chances of miscommunication. In this context, it's difficult to make a case for unruly visual practices that will almost certainly make things less clear. The goal of most graphic images in design engineering is to be clearly defined and unambiguously understood. Drawing, also explorative sketching, is taught in this context. Perspective



drawing lessons usually begin with learning to construct simple cubes and cylinders in perspective and continue towards increasingly complex integrated forms and rendering techniques. This approach is very effective when spatial design ideas need to be visualized before they exist in three dimensions. However, imagined ideas are never finished in the imagination, the eye and hand must work together to first bring an image into the world. Drawing does more than just re-present imagined ideas it is *a way of learning* that facilitates building on ideas, thinking through problems, or just giving personal fascinations the attention and time they need to grow into more purposeful actions. This kind of unfinished drawing, made in a process of working things out, is commonly called a sketch. A sketch takes place in an informal, explorative and dialogic process. When the purpose of drawing is to learn by doing, learning conditions will need to encourage these exploratory and dialogic visual practices.

Every experience is a moving force. Its value can only be judged on the ground of what it moves toward and into (Dewey, 2015, p.38).

An early alternative to the dominant regimes of academic drawing instruction came from the Victorian art critic John Ruskin. Ruskin founded a school of drawing in Oxford England in 1871 which is still running today. His drawing manual *The elements of drawing* (Ruskin, 2005) was first published in 1857. Ruskin was opposed to routinised methods for drawing education. This practical drawing advice, written in the form of three letters to those wanting to learn to draw, was also a protest against the then current tendencies in the academic teaching of art. He believed that close observation of nature, rather than dexterity and neatness should be the basis of learning. He argued that because these academic drawing techniques often directed learning towards the vain goal of 'accomplishment' and away from the most significant

and potentially transformative experience of drawing, which was to come to see and feel with greater attention and sensitivity. He believed that attentive looking should be central to drawing education.

Therefore, the chief aim and bent of the following system is to obtain, first, a perfectly patient, and, to the utmost of the pupil's power, a delicate method of work, such as may ensure his seeing truly. For I am nearly convinced that, when once we see keenly enough, there is very little difficulty in drawing what we see; but, even supposing that this difficulty be still great, I believe that the sight is a more important thing than the drawing; and I would rather teach drawing that my pupils may learn to love Nature, than teach the looking at Nature that they may learn to draw (Ruskin, 2005, p.13).

More than developing drawing skill, the most important value to the practice of drawing for Ruskin was to develop a non-mechanical 'delicate' hand and eye that could see the subtle variations of form and line in nature. The task of drawing was not just to copy nature, to draw a thing as it is, but to recognize in nature the way things are going. Unlike the positivist logic that informed much academic drawing Ruskin's drawing instruction focused on attentive observation and empathy with a natural world.

Perhaps the most substantial break with the conventions of linear perspective drawing and painting can be traced to the collage experiments of early modernist artists. Once the drawn or painted line began to question the conventions of perspective, it wasn't long before the line was liberated from representation altogether. At the heart of the break with representational art was a design school, the Bauhaus. Here, the 'basics' of drawing education were not cubes and cylinders in perspective but primary graphic elements. The drawing lessons of Wassily Kandinsky, Joseph Albers and Paul Klee distilled drawing to the foundations of points, lines, planes and colours, Kandinsky (2004) wrote about finding a line's 'inner necessity', Paul Klee wrote about the nature of active and passive lines (Klee and Moholy-Nagy, 1968). These visual fundamentals were then used to explore formal, conceptual and philosophical questions. Bauhaus design drawings are in many ways aesthetic and conceptual counter-points to glossy presentation drawings based on the skilful routines of rendering techniques.

For drawing is, like the English language, a great absorber of change, of inconsistency, of variability, of whim, of perverseness, of dogmatism and of waywardness. There is after all no such thing as a correct drawing. There is no ultimate obligation of the drawer to perform to a formula (Cook, 2014, p.228).

The practice of drawing can open a space for learning by analysing and problematizing visual conventions and creatively exploring alternatives. An awareness of the influence of our chosen methods on design processes (and by consequence the resulting designs) is key to creative and critical design practices. Experiments and challenges to dominant visual conventions helped to shape our current built environment. Representational schemes such as axonometric drawing eventually came to define a whole generation of critical architectural practice in the 60's and 70's (Cook, 2014, p.21). The equalising and flattening of the axonometric grid creates an in between space. Stiffly spatial yet flat, pushed up against the picture plane. The scribbles of Frank Gehry and fluid ink line drawings of Zaha Hadid gave shape to the spatial dialogues that shaped their architectural languages. Playing with formal conventions can be a way of evoking more reflexive drawing practices that give representations a conceptual strength that are easily lost in the 'naturalism' of perspective drawings. Like architecture design-engineering need not limit its visual strategies to routine strategies but might challenge students to explore alternatives in an effort to find the visual idioms that suit their personal ambitions and values. A critical reflexive drawing practice could be a foundation for creative practices that traverse diverse professional fields.

CONTEXT

Planning in liquid times

If efficient education connects predefined learning objectives with non-deviating paths, it is successful when students have reached its predefined competency targets on time. These straight and efficient learning paths may even suggest a moral dimension. Tracing the meaning of straightness to modernity Tim Ingold quotes Le Corbusier;

The straight line is decisive, clear and hard-working, while the meandering line is capricious, confused and lazy. The man of reason 'walks in a straight line because he has a goal and knows where he is going, he has made up his mind to reach some particular place and goes straight to it' (Ingold, 2007, p.153).

Yet, the top-down planning and failed utopian projects of high-modernism have since it made clear that designers (and planners) cannot assume a tabula-rasa and build a new world from scratch. Design must engage *with* the terrain it inhabits. In a situation where social, personal, technological, cultural and economic change is a given, higher education is faced with the difficult task of creating meaningful and relevant learning for an unforeseeable future (Bauman, 2006). Competency-based learning, learning-to-learn, life-long-learning, and 21st century skills are just some of the strategies that have been used in education to try to generate 'future proof' education by encouraging flexibility, creativity and self-direction. It is argued that only those able to adapt to unpredictable situations will prosper in the professional work forces of the future. In a fast-changing situation routine procedures are dangerous. The knowledge that something has worked before is now no guarantee that it will work again. 21st century professionals need to be sensitive to emerging conditions and intrinsically motivated to learn and

reassess the appropriateness of the methods and tools they use in each situation anew. The need for flexible, creative, reflexive and self-directed learning is, however, coupled with a social obligation to offer education to large numbers of students. As part of the Europe 2020 strategy The European Commission set educational targets. In 2020 40% of all 30 to 34 year olds should have completed a higher-education degree (European Commission, 2016). Administrative and institutional bureaucracies coupled with neo-liberal economic pressures generate pressures for standardization and efficiency. It is not just education, but mass-education that must encourage flexibility, creativity and self-direction.

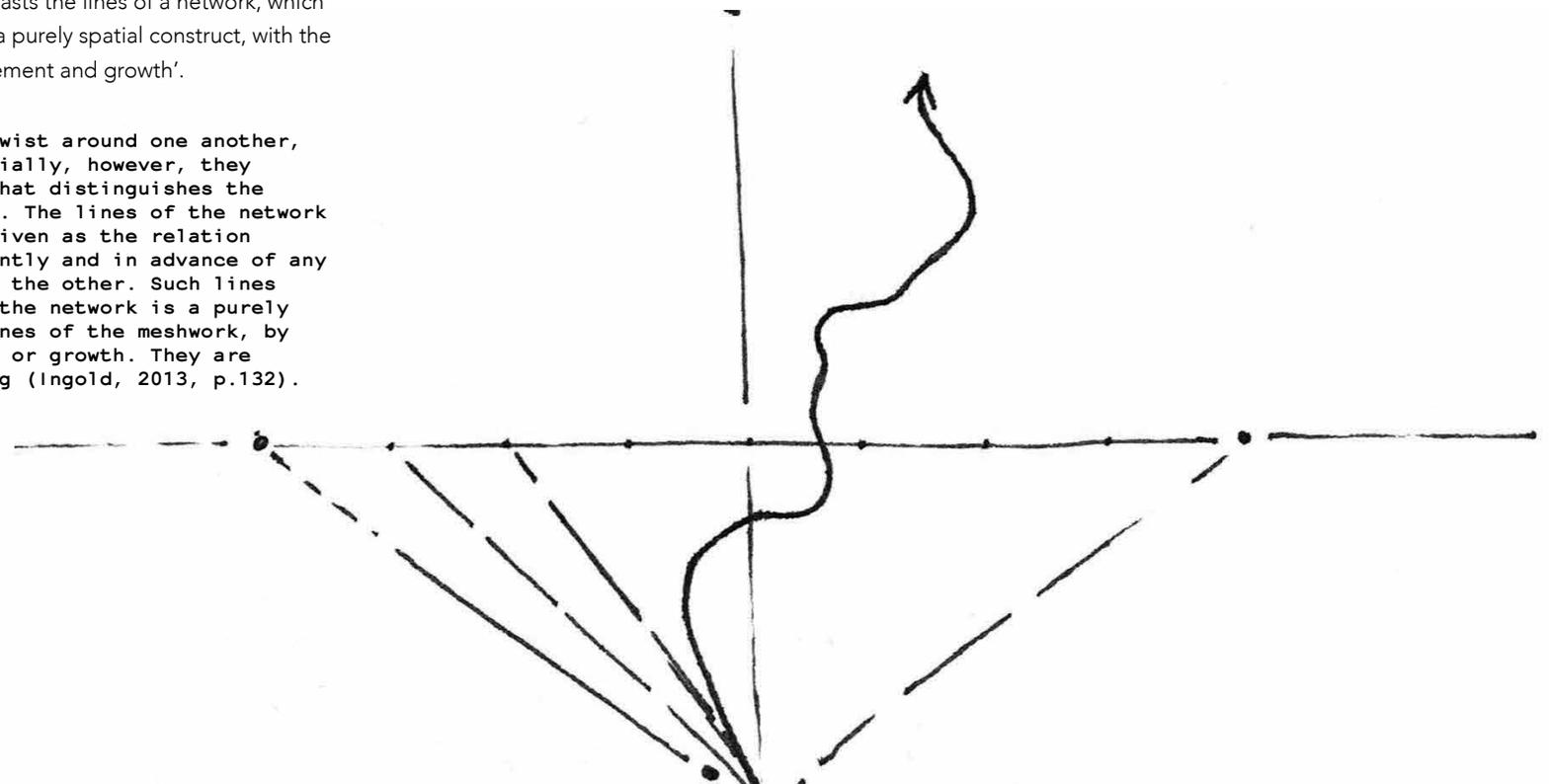
While an efficient learning line would need to follow the shortest distance between two points, a flexible line would adjust its goals and evaluate its behaviour en route. A flexible learning line necessarily deviates *because* it is in conversation with the situation, it responds to an emerging terrain. This is not a lack of discipline; a change in direction is a sign of active presence and increased attention. A turn is made *because* interaction generates new insights, as goals take shape and are reshaped the path 'becomes'. This kind of path requires a wider focus, peripheral vision and a heightened awareness of a whole shifting field of ambiguous potential. While Klee's active line is described as "moving freely without a goal" (Klee and Moholy-Nagy, 1968, p.16) aimless wandering is not the purpose of this active learning path. In response to the unproductive debates between proponents of so called 'progressive' and 'conventional' education, John Dewey (2015) addressed the issue of freedom in education in a 1938 publication titled *Education and Experience*. As the American school system shifted from a traditional system based on principles of authority and control to a system that understood learning as an essentially social process, Dewey clarified that the simple removal of strict external control and fixed classroom seating was not the central aim of progressive education,

It is then sound instinct which identifies freedom with the power to frame purposes and to execute or carry into effect purposes so framed. Such freedom is in turn identical with self-control; for the formation of purposes and the organization of means to execute them are the work of intelligence (Dewey, 2015, p.67).

The central concern of progressive education was not only to free students from oppressive and hierarchical educational orthodoxies but to foster in them the motivation and ability to 'frame purposes' and to carry these purposes into effect. This process of 'framing purposes' and 'organizing means' is the central concern of design practice and pedagogy. Viewed from both the perspective of design practice and pedagogy it's clear that learning must not be reduced to the routine instrumentalism of training. Learning is a value in and of itself. Meaningful and critical learning must allow students to engage with their learning with agency supported by a culture that encourages active questioning and the risk of transformation. The task of education cannot be subsumed under standardized methods designed to efficiently mass-produce intellectual labor in educational training schemes for industry. It is most empowering as preparation for a self-managed and critically engaged social life (Giroux, 2011). Education reduced to the status of service provider for the needs of economies and industries becomes a system to be managed and optimized. It is organized by an instrumental logic that attempts to connect predefined objectives with efficiently straightened learning lines. A questioning and transforming learner is however, active in shaping the learning path and forming objectives in the process of growth and transformation. Tim Ingold (2013) contrasts the lines of a network, which are connectors that 'lack duration' and are a purely spatial construct, with the lines of a 'meshwork' that are lines of 'movement and growth'.

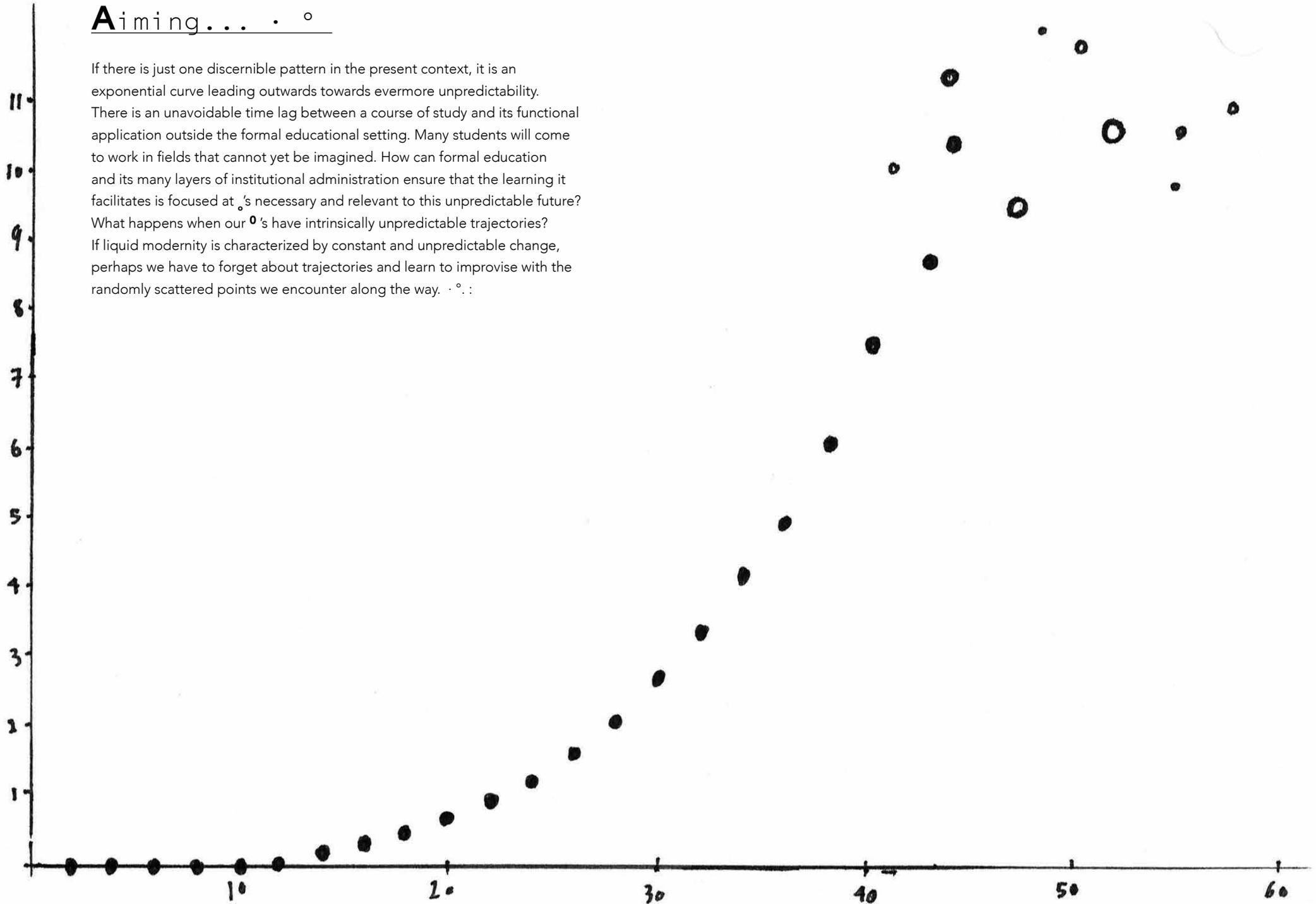
These lines may loop or twist around one another, or weave in and out. Crucially, however, they do not connect. This is what distinguishes the meshwork from the network. The lines of the network are connectors: each is given as the relation between points, independently and in advance of any movement from one towards the other. Such lines therefore lack duration: the network is a purely spatial construct. The lines of the meshwork, by contrast, are of movement or growth. They are temporal lines of becoming (Ingold, 2013, p.132).

Unlike the straight lines of network, meshwork lines meander and do not connect at predefined points. The form and structure of the mesh is simply the trace of multiple self-directed learning paths. Each line navigates a shifting (liquid) topography as a 'self-directing self' is formed. The mesh is the result of the paths that emerge along the way. In contrast to the network, this metaphor of the meshwork opens a space to understand learning as reflective practice of framing goals and developing strategies that might bring individual ambitions into effect. Forming and reforming objectives as learning takes place, anticipation and dialogue about what is ahead and the search for what is individually meaningful can evoke enriching and reflective learning situations. While the clear straight lines of a network facilitate speed and efficiency they leave little space for reflexive creative practices. In a meshwork routine operations can be questioned, problematized and reformed. The lines that make a meshwork are lines 'on a walk' forming and reforming both directions and purposes as they go along. If education is to be more than just professional training it needs to risk the uncertainty of these reflective, emergent learning paths.



Aiming... . °

If there is just one discernible pattern in the present context, it is an exponential curve leading outwards towards evermore unpredictability. There is an unavoidable time lag between a course of study and its functional application outside the formal educational setting. Many students will come to work in fields that cannot yet be imagined. How can formal education and its many layers of institutional administration ensure that the learning it facilitates is focused at 's necessary and relevant to this unpredictable future? What happens when our °'s have intrinsically unpredictable trajectories? If liquid modernity is characterized by constant and unpredictable change, perhaps we have to forget about trajectories and learn to improvise with the randomly scattered points we encounter along the way. . °. :



Render <----->Sketch
Specify<----->Explore
Monologue<----->Dialogue
Straight<----->Searching
Instrumental <----->Immanent
Conventional<----->Individual
Declarative<----->Inquiring
Noun<----->Verb
Control<----->Uncertainty
Clarity<----->Ambiguity
Security<----->Risk
Skill<----->Reflexivity
Didactics<----->Pedagogy
Institutional<----->Personal
Method<----->Sensitivity
Objectives<----->Emergence
Focus<----->Peripheral vision
Content centred<----->Student centred
Efficient<----->Reflective
Commuting<----->Wayfaring
Constructing<----->Growing
Utopian<----->Topian
Network<----->Meshwork

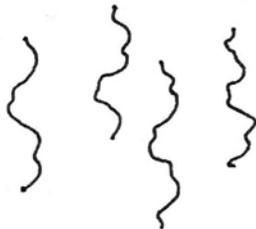
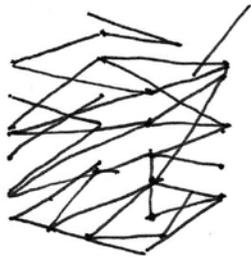
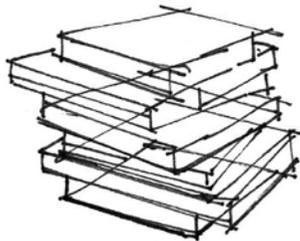
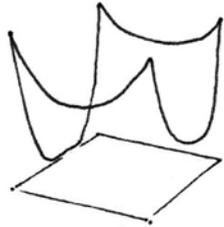
Learning teaching context

In the precarious 'liquid' context of a discontinued Product Design department and the first years of a newly conceived broad Engineering degree a number of deviations from the standard routines of perspective drawing instruction were explored. A collaborative drawing session was held during a first-year project. A Design Aesthetics course was altered to include small drawing assignments, creative drawing workshops were run in a 3rd year Minor and drawing classes during a Design History course explored the potential of spatial verbs.

The broad Engineering degree had over 700 first year enrolments this year. It offers graduate profiles in: Mechatronics and Robotics, Business Engineering, Intelligent Devices and Sensing, Interaction Engineering, Sustainable Energy Systems and Industrial Design Engineering. The education project described in this thesis took place in both the new broad Engineering curriculum and the now discontinued Product Design curriculum. After the reorganization, as technical expertise from the Product Design department is being integrated into the new broad Engineering degree more human-centred subjects like Semiotics, Aesthetics and Conceptual Design courses have been discontinued. A salient point for drawing education is that in the new curriculum drawing is no longer offered in stand-alone courses but integrated into larger projects. Before the transition to a broad engineering degree, the drawing courses in the Product Design graduate profile had already been drastically cut back. Over the last four years' class sizes increased by a third from 24 to 36 students. Lessons were shortened from 2.5 hours to 1.6 hours and the amount of lessons was reduced by half. To cope with these reductions drawing classes were 'optimized' in order to

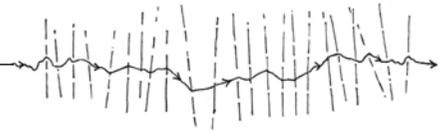
efficiently train just the bare foundations of perspective drawing. With the integration of the discontinued product design department into the Engineering program, this first term foundation in perspective drawing was further reduced to just a number of worksheets about perspective and two non-committal workshops offered by student assistants. Needless-to-say, the context of this project is a dynamically changing large scale institution. A foundation drawing course will again be given next year. Integration of drawing into a broader range of content areas might effectively increase the attention given to visual communication in the curriculum. However, there is a need to find a balance between the instrumental requirements of drawings to represent ideas (which requires skills and knowledge transfer) and the practice of drawing to enrich the learning process in a broader sense.

To contextualize I will give a brief overview of the Industrial Design Engineering program. When new students enrol for Engineering they are required to choose from one of four entrance profiles, each entrance profile is linked to a graduate profile. During the first year of study it's possible to switch between departments. At the end of the first-year students have to commit to one of the graduate profiles. In the first semester, all Engineering students (there were approximately 700 first year students last year) follow a broad program which includes a technical design project, research into technical innovations, mathematics, physics and a studio project related to the chosen graduate profile. In Industrial-Design-Engineering this course is called Product Analysis. It's in this course that the collaborative drawing workshop took place. Product Analysis is a two-part semester long course in which students dismantle a mass-produced product and research all functions, parts, materials and the manufacturing techniques used to make it. Then, during the second half of the course, students redesign this product to 'first concept' level (presented as drawings) for an allocated target group. Drawing lessons are intended to develop the drawing skills needed to describe and present their concepts visually. The second semester includes courses in; collaborative design (user research and ergonomics), interface and cognition (writing protocols and making test models), Product and Technics (mathematics and statics) Product Dimension (designing with a program of requirements), Product Mechanics (making a mechanical device) and Product and Form (a design-history course written assignments, presentations and a drawing component).



PRACTICE

Going along



What is life, indeed if not a proliferation of loose ends! It can only be carried on in a world that is not fully joined up, not fully articulated. This the very continuity of life - its sustainability in current jargon - depends on the fact that nothing ever quite fits (Ingold, 2013, p. 132).

Practice and theory are not joined instrumentally, they weave together, going along in time. The learning situations described hereunder represent an explorative part of my teaching practice. The descriptions are intended to contextualize, narrate and reflect on practice as it occurs within the affordances and constraints of this particular situation; a large educational institution in a period of transition. Writing is therefore both descriptive and an effort to learn in the dialogic relation between reading, talking, listening, teaching, drawing and writing.

Collaborative drawing

During a first-year design project I introduced a collaborative drawing exercise into drawing lessons for a first-year project called Product Analysis. Classes of approximately 30 students were asked to make groups of 5 or 6. The exercise supported a requirement to generate ten first concepts for an ideation phase in the design project. In the exercise, product ideas are drawn in quick 3-minute sketches before being passed along to be added to by a peer. As students pass drawings along, a drawing is also received. This is repeated until all pages have made a full circle and have returned to the original drawer. The exercise is a highly-structured way to encourage the

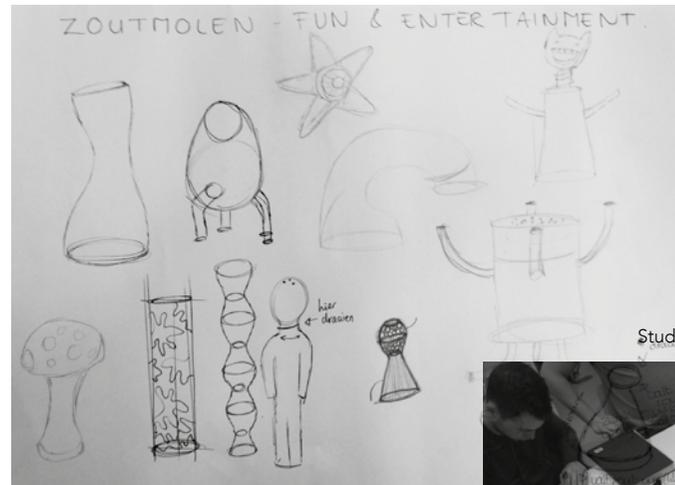
cross-fertilization of ideas and have students respond with drawings to the unexpected choices of others. Similar exercises such as "Design Charrette" (Curedale, 2013) or "Brain drawing" (Boeijen et al., 2010) are not uncommon to design practice; this version of the exercise was adjusted so it could be completed in just over an hour. During the exercise a usually busy and distracted class became intensely focused, the pressure of timed 3-minute sketching stopped all chatter and left only the sound of pen nibs on paper and the occasional shifting chair. Then, each time the timer rang, it snapped students out of their concentrated sketching and they started to talk, laugh and point at each other's drawings. Some students passed pages along, eager to see the next page, others tried to hold onto to their own drawings just a bit longer, determined to finish a detail before passing their sketch on. After each exchange the timer was reset and the next sketch was made. These intervals were repeated until each student had drawn on all pages at their table.

The videos I had made of the class revealed little more than I had already observed during the class, however, two group discussions a week later gave an insight into the student experience on the drawing exercise. As expected students confirmed that it had helped them to discover a wider range of alternatives.

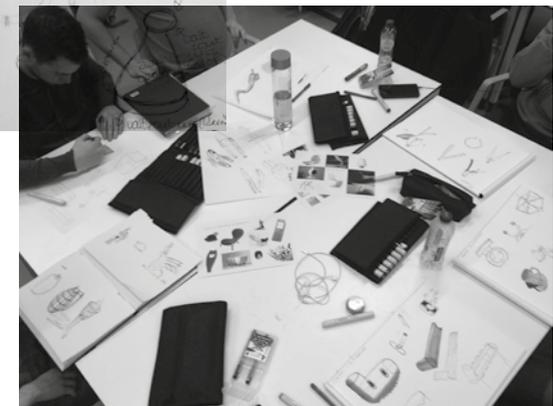
It helps you get further when you get stuck, it triggers new ideas, you can take some of these further. Someone drew a something with an air pressure system, this opened a whole new line of thought for my design. I now know what my classmates are doing. If I think of a design solution for someone next week, now I'll call them (See appendix A - my translation).

This sense of responsibility for the work of peers was unexpected. As noted by a colleague drawing teacher; "the quality of the sketches was not high, but they had fun, it really motivated them" (appendix A - my translation). The exercise seemed to shift the focus of learning from the transfer of content (skills and knowledge) towards learning domains related more to incentives (motivation, emotion, volition) and interaction (action, communication, cooperation). Educational theorist Knud Illeris (2009) notes that these dimensions of learning are always inter-related. A learning experience that increases motivation and cooperation can have a lasting impact on knowledge and skills, just as learning new skills with training can have an

impact on motivation, emotion and volition (Illeris, 2009, pp. 7 – 20). Seen from the perspective of knowledge and skills transfer the exercise was not immediately productive. The sketches were often clumsy and imprecise and perspective mistakes in student's drawings were not corrected. The exercise did, however, strongly emphasize the interactive and social dimensions of learning that are commonly suppressed by more classical and instructional drawing classes. The timed intervals in the exercise created pressure that seemed to release students from the responsibility to finish and refine their drawings. A notable effect, extending well beyond the frame of the drawing class, was brought to my attention by a project coach a week later who reported never before seeing such uninhibited first year students when it came to drawing. According to this engineering teacher the typical reluctance of students to draw seemed to have dramatically reduced after the collaborative drawing session. This this small deviation from a skill focused program, to include a structured, collaborative experience seemed to have the potential to generate incentives and forms of co-operation that could reduce inhibition and positively affect motivation.



Student drawing / collaborative drawing. 2017

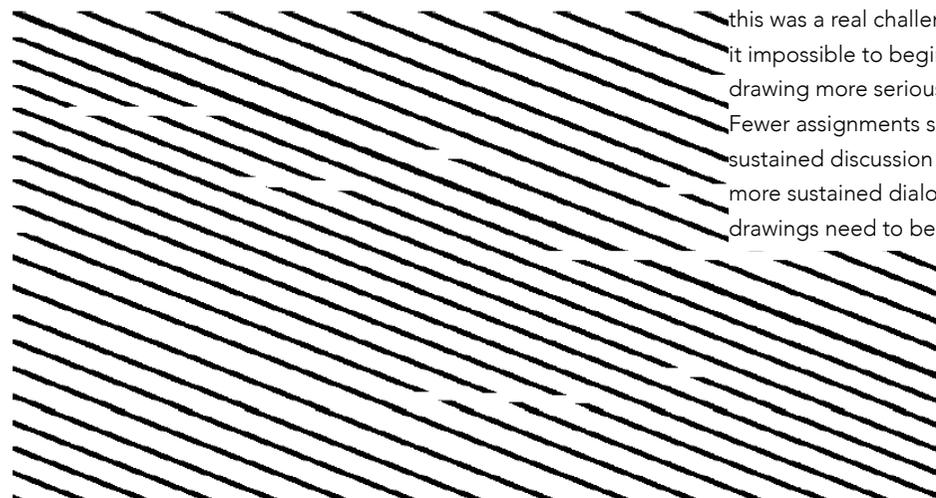
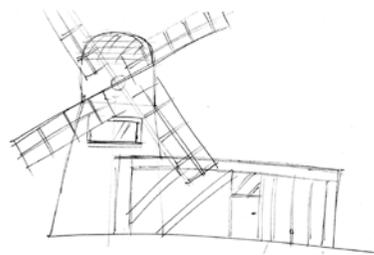


An ambiguous challenge

Aesthetics was a 2-study-point course that was part of 2nd year of the Product design curriculum, it ran for the last time this year. It has been discontinued in the new broad engineering curriculum. Weekly assignments were intended to motivate group discussions during 50-minute weekly coaching sessions. These took place in train-coupe type seating in the open-plan setting of a 'study landscape'. This added to the informal character of the sessions but also exposed the group to the noise and distraction of a busy shared space. This year, I was given the task to redesign and coordinate the course, which gave me the opportunity to edit the course-guide, add sketching assignments and design a collective and speculative final assignment based on the theme "possible futures".

Even though the scheduled tutor sessions were just 50-minutes long, the small group size (up to eight students) was ideal for reflective group conversations. In addition to reading and discussion assignments required students to bring printed photographic images to coaching sessions as well as make drawings related to aesthetic concepts. Having these 'things' on the table facilitated our discussions and helped create a reflective and dialogic learning situation. The response to the drawing assignments was diverse, some students appreciated the freedom to explore drawing in their own way, others got completely stuck and wanted clear instructions on what, and how,

Student drawings of aesthetic concepts.
Aesthetics A, 2017.



to draw. At two moments in the course students were asked to write a half page reflection. Commonly students expressed that they had expected Aesthetics would be a 'vague' subject.

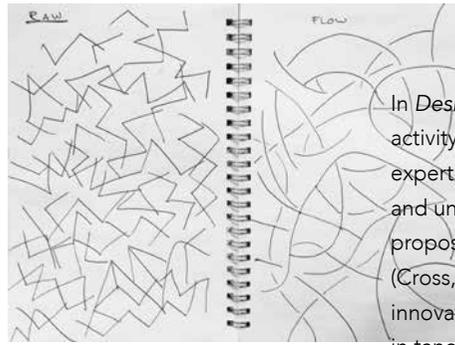
My first thought about this subject was that it would be too vague and that I would therefore automatically not find it interesting (See appendix A - my translation).

One assignment required students to read an article by design theorist Paul Hekkert (2006) titled *Design aesthetics: principles of pleasure in design*. Students were required to find photographic examples and make drawings of the concepts described in the article. These were then discussed during the weekly 50-minute coaching sessions in groups of eight. Students were encouraged to explore drawing strategies in their own way. While finding photographic examples was no problem for most, many students struggled with the drawing assignments. Drawing lessons in the first year of study had given students the skills they needed to describe spatial objects, however, to express aesthetic concepts such as 'unity in variety' or 'maximum effect for a minimum of means' (Hekkert, 2006) these approaches to drawing often seemed to be too oriented towards description and definition. Here, drawing practice needed to 'think' and act in a different way. Lines no longer needed to delineate and describe spatial forms, they could also function as primary elements in graphic compositions. Lines could behave more like objects in their own right. In the context of a small coaching group, different approaches to exploring these formal aesthetic concepts by means of drawing instigated instructive dialogues between students. The drawing assignments only required a small sketch, but for a lot of students even this was a real challenge. Not knowing what to draw, these students found it impossible to begin. Some of the students who took the challenge of drawing more seriously made insightful discoveries by means of drawing. Fewer assignments spread over a few weeks might have allowed for a more sustained discussion with drawing, and given the opportunity to develop a more sustained dialogue with and around drawing. To learn with drawing, drawings need to be given time and attention. During these 50-minute



▲ Student sketch of two words from the 'possible future' word cloud. Aesthetics A, 2017

▲ Student word-cloud made during a coaching session. Aesthetics A, 201



In *Design Thinking* Nigel Cross (2011) offers a useful description of design activity and thinking based on a series of case studies. His studies show that expert designers commonly have a higher than average tolerance for ambiguity and uncertainty. Designers "have learned to live with the fact that design proposals may remain ambiguous and uncertain until quite late in the process" (Cross, 2011, p. 12). According to Cross an important feature of creative and innovative design thinking is that seemingly incompatible ideas can develop in tandem with each other. It's this tolerance for ambiguity, he argues, that allows new patterns to synthesize in innovative ways. Interestingly, feedback from students in the aesthetics course suggested that students who responded negatively to the ambiguity of the weekly assignments at the start of the course gained a tolerance for ambiguity once they began with the final assignment.

At the start, I thought the subject was weird and vague. I couldn't work out what I had to draw because I had already made photo's. That's why I didn't really understand the assignments. I also didn't understand how I could show the essence of something with a sketch. Later it became a bit clearer but it remains vague. I really liked doing the final assignment. I instantly had ideas and was keen to start...I really liked that we were allowed to do our own thing. We were left free in our creativity, and I really enjoyed that! (See appendix A - my translation)

sessions the texts, photos and drawings of up to eight students needed to be discussed. During these group discussions I tried to limit my input to questions, directing them around the group so that everyone had an opportunity to speak.

On the whole, students who had made abstract drawings seemed to engage most directly with formal aesthetic concepts. Abstract images had the advantage that they functioned more like material objects themselves. These drawings didn't represent ideas but rather had to perform them. This difference drew my attention to the didactic value of constraining assignments with the aim of directing student experimentation towards more fundamental learning. In this case, I think limiting the assignment to abstract drawings would have challenged students to think about drawing differently from the start generating a more rewarding learning experience for all students. A set of instructions might direct learning without becoming dogmatic. Instructions can work like small design challenges, while diverse interpretations of these instructions might offer 'things' to discuss in coaching sessions. While assignments earlier in the program might have benefited from clearer constraints, the final 'possible futures' assignment might have been introduced earlier to give more time for enriching group dialogues and iterations.

It's difficult to judge whether this changed experience occurred due to a growing familiarity with the subject area, developing safety in the group, or the increased autonomy in the final assignment. However, it did give cause to consider the relationship between efficacy and the experience of uncertainty in education. In this case, a student seemed to gain a tolerance for ambiguity once she was given the time and space to reflect on values and shape her own final assignment. Student reflections from the final week of lessons suggested that once the opportunity to define themes and values was given, the ambiguity of the design challenge was no longer experienced negatively.

While some students found the sketch assignments under-defined and 'vague' others really appreciated the opportunity to explore alternative way of drawing,

I really liked the combination that was made with drawing in this subject. Adopting other drawing styles and thereby representing different feelings and thoughts really spoke to me. During the first year of the study we were taught to sketch in a particular way. In Aesthetics it was not the intention to draw in this way. I really liked this because there are so many ways to communicate ideas with sketches (See appendix A: my translation from dutch).

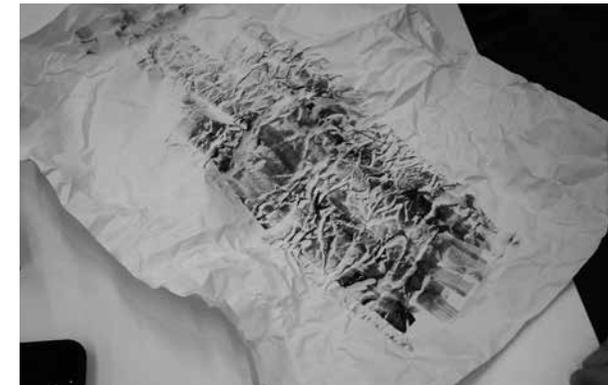
The diversity of responses would suggest that the experience of these more open-ended drawing assignments is largely dependent on personal preferences. An interest and affinity with drawing as well as a general tolerance for ambiguity might contribute to shaping the experience. However, making decisions, trying things out and reflecting on implications in relation to abstract concepts are important parts of much design practice. The task to make explorative drawing experiments and share them, giving them a place on the table during discussion, helped to bring drawing into a dialogic space. If these discussions could lead to new drawings, further discussions, and more drawings, drawing might become more integrated, explorative and dialogic by taking an active role in group discussions. Aesthetic assignments generate a space for personal interpretation, sharing judgements and values generates a dialogic learning environment. In this context, the limits of language are experienced very quickly, by giving drawing a role, it becomes the other half of language. In a dialogic learning environment drawings can produce graphic objects to think with. A lesson program with time dedicated to drawing and group discussion could help students develop far more reflective visual practices.

Negotiating a word cloud for the possible future assignment



Minor: The essence of designing

The Essence of Designing was 3rd year Minor that was part of the now discontinued Product design graduate profile. It was offered for the last time this year. The course gave students a full semester to explore a self-directed design project. The course had few directives, its main objective was to offer guidance to students as they find and follow a personal fascination and self-direct their own design process. I offered a number of drawing workshops at the start of the course. These workshops were not compulsory and were not graded. They took place during the very early stages of the course before students had any clear objectives for their projects. Students have since found direction and purpose in their research, their projects are diverse, for example, one student is developing interactive wearable sound devices, while another is developing a leather made of fish skin. For the first workshop, I began with the open question "What do we want from these workshops?" In four groups students wrote and connect words around this central question. Some of the key themes generated in the mind-maps were; (my translation from Dutch) self-development, overcoming creative blocks, working together, developing a personal style, finding inspiration, drawing before thinking, experimenting, deepening, being freer in sketching, responding to arbitrary processes. The mind-maps confirmed that students were eager to experience a more open and explorative approach to drawing than they knew from the foundation year drawing courses that most of them had followed two years earlier.



Material and surface exploration

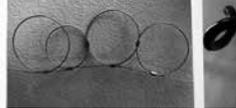


Workshop: Departing

I want to think of making, instead as a process of growth. This is to place the maker from the outset as a participant in amongst a world of active materials. These materials are what he has to work with, and in the process of making he 'joins forces' with them, bringing them together or splitting them apart, synthesising and distilling, in anticipation of what might emerge (Ingold, 2007, pp. 20-21).

The first drawing workshop for the Minor focused on the themes: "departing", "exploring", "care" and "tactility". I requested that students bring to the class an alternative drawing material and an object that they cared about. After the initial mind-mapping exercise I held a short presentation about my research into drawing practices, departures and creativity. Two questions were posed: "How can we find inspiration and surprise ourselves when we draw?" and "what is the nature of drawing when it is an art of inquiry?"

To begin any process of exploration, I suggested, we have to depart from what we already know. After a short discussion, we started with an exercise conceived by a drawing teacher Kim Sloane called "the atomic ball of string". (Thinking through drawing, 2017). It starts by asking students to imagine two images, the first is an image of an atom with electrons circling around it, the second, a ball with lines wrapping around it in all directions like a ball of string. Using charcoal on large sheets of paper students were asked to draw spheres by imagining and enacting the paths of these lines. Unaccustomed to drawing with charcoal students started tracing these paths. The goal of the exercise was to draw a ball that expressed both form and energy. After about 15 minutes of sketching we laid all the drawings out on the floor and discussed which drawings best expressed dynamic energy and spatiality and how it felt to draw this way. The exercise was a way to break with previous lessons, and to illicit an experience whereby students engaged in spatial drawing without delineating outlines or constructing perspective solids (common to perspective drawing in design). The intention was to experience the line as a generative force itself. After the exercise, we laid out all the drawings out on the floor we discussed the relationships between line, form, outline and energy in drawing.



Two comments from student reflect the challenge of negotiating between instruction and creative self-directed exploration.



But while drawing a dynamic sphere could be good warming up exercise, I experienced it as a too structured and unpleasant start (See appendix A – my translation).

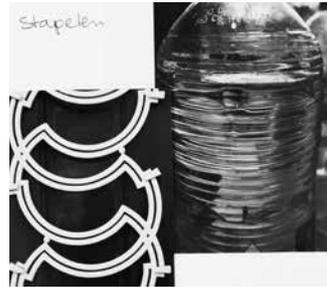
Especially the first exercise with charcoal was inspiring and a good exercise to generate insight into the relationship between line weight and depth, dynamics and energy in a sketch (See appendix A – my translation).

the atomic ball of string exercise and the drawings laid out on the floor for appraisal afterwards.

Next, we went on to experiment with the drawing materials that students had brought to class. Among these drawing materials were beetroot juice, tea, lipstick, Indian ink, coffee, charcoal, wax, and paints of various kinds. I explained that the objective was to come to understand the qualities, constraints and affordances found in the interactions between mediums, tools and surfaces. Engaging with, and thinking about, material qualities seemed to shift the focus of many students quite naturally away from spatial representation and towards material explorations. Students became immersed in asking “what happens if...?”. I walked around and spoke with students individually as they worked. There were experiments with crushed chalk, beetroot juice, melted wax, watercolour, ink and paint. After about an hour of material experimentation I suggested a coffee break and invited the class to walk around and talk to each other about these explorations. After this, I asked students to consider the concepts of care and tactility in drawing. Drawing is not only the product of sight but also touch and movement. Sight can be distant and objectifying, while touch is inherently intimate. Each kind of touch has meaning, it’s possible to gently caress a surface, or decisively mark it with a gesture. A line can be the trace of hesitant movement or a mark of reckless abandon. In this sense, a drawn line is an indexical sign of the pressure and speed at which it was made. We often ‘read’ these signs intuitively identifying with the way a mark has been made. I posed the question; how will you draw this thing you care about? While the initial material experiments in this workshop triggered a heightened awareness of the agency of tools and materials, the concepts of care and touch seemed to motivate a more delicate handling. Attention was paid to the potential

meaning of line and gesture. A number of students focused on careful and patient observational drawings, not with a cool analytic eye, but rather with attention and care. Drawings became more reflective and delicate, lines were variegated and expressive.

Workshop: To line



**In other terms, drawing unfolds a novel sense that does not conform to a pre-formed project. It is carried away by a design that joins with movement, gesture, and expansion of the mark [trait]. Its pleasure [jouissance] is the sensual pleasure of this unfolding, or the pleasure of this unfolding in so much as it invents, finds, and summons itself further, projected onto the trace that has nevertheless not preceded it ...
... To draw is at once to give birth to form – to give birth in letting it be born – and thus to show it, to bring it to light (Nancy, 2009, p.22) .**

In my own drawing practice the gesture of drawing seems to trigger a personal anticipation, it elicits an identification with a projected path. I make the line “happen” and the way it (and I) behave determines what the drawing becomes. The pressure I transmit through the drawing tool, the speed I move, the pivot points I find in my body all affect the specificities of the line. Simultaneously I am aware of the interplay between my intention and the surface, my body, the tool, the material. I wanted to bring this dimension of drawing into a workshop in order to facilitate a non-instrumental, explorative and reflective experience of drawing.

Tim Ingold’s taxonomy of lines, described above (what is a line?) and Richard Serra’s *Verb list compilation: actions to relate to oneself* (Serra, 2017) were points of departure for a second workshop in the Product Design minor *The Essence of Designing*. A week in advance I had asked students to make photographs of lines in three categories; threads, traces and one other self-determined category. At the start of the workshop I held a short presentation with images of lines, drawings and quotes from writers, artists and architects such as; John Ruskin, Paul Klee and Le Corbusier. I then handed out a copy of Serra’s *Verb list compilation: actions to relate to oneself* (Serra, 2017).



Following this introduction, we laid out the images of lines that students had brought to the workshop on a table to observe and compare what everyone had found. After an initial discussion where students explained and described what they had brought to the table, we began categorizing these lines again, but this time not as threads or traces, or as the self-chosen categories, but rather, in relation to words that might suggest what these lines were *doing*. I asked students to propose verbs. As students suggested these verbs they were written on paper and placed on the table to be surrounded with associated photos on lines. Many images could be associated with two or more categories. This led to more focused discussions: the difference between twisting and meandering, for example, facilitated a more attentive observation of the specificities of different line qualities. After a discussion



of about 30 minutes a selection of clusters and words had been made: hanging, twisting, rolling, stacking, dripping, pointing, branching, repeating (here translated from Dutch into English) were some of the words used. These words were then written on the whiteboard in the classroom. Clustering images structured the discussion and facilitated a sustained observation and dialogue.



Next, I asked students to choose a verb and an associated image to explore in a drawing. I asked students to pay attention to how it felt to *do* the line, and, to try to imagine the lines intention while *doing* it. While focusing on the gesture and intention of the line, I suggested they try to draw, not by representing the line but by enacting it. Once a point is set into motion, becoming a line, the behaviour of meandering, twisting or hanging generated the character and trajectory of the lines that were made. This drew attention to line qualities and encouraged experimentation.

These drawings were open explorative experiments, inquiries into the constraints and affordances of diverse graphic materials, tools, surfaces and bodies. Student drawings were explorative in the sense that they preceded the formation of a clear program, a design challenge or problem to be solved. The purpose was to learn by noticing the patterns and opportunities that emerged in the process of making. An open explorative inquiry can lead to discoveries that become more purposeful goals. Once these goals begin to be defined, action can become more convergent. Once (tentative) goals are made more explicit, 'explorative experiments' become "move making" experiments.

Some students found it difficult to sustain this mode of open experiment. This suggests that when students lose motivation in an explorative process an effort should be made to recognize emerging patterns and make (tentative) goals more explicit. The methods used for inquiry have a strong influence on the kind of discoveries that are made. These explorative experiments opened a space for students to think about mark making reflexively. Importantly, experimenting with materials, tools and methods helped us to start questioning routines.

These workshops revealed that reflective dialogues are important for a number of reasons: they give time and value to noticing and refine sensitivities towards unexpected outcomes, they support a culture of sharing diverse perspectives, they help us develop a more nuanced language that can speak about the qualities that emerge from practice and they affirm the importance of explorative action and reflection. Explorative action can be playful and fun but it also needs to be taken seriously. Group dialogues around drawings can help to draw out and identify discoveries and to value the risk of deviating from standard routines. This seems important for the social dimension of learning by creating a culture that supports creative experimentation.



LOOKING FORWARD

Towards explorative and dialogic drawing

One could almost treat a line as a verb, and say that in the thing's growing - in its issuing forth, in its making itself visible, as Paul Klee would say, it lines (Ingold, 2013, p.135).

Sketching brings action and reflection together as praxis. It is an embodied kind of learning that acts on, and with, materials. Reflecting on the 'back-talk' that sketches generate, and sketching again, constitutes a form of thinking-thought-making. What is central to sketching is that it is done *to learn*. During a design process sketching operates in a mode of anticipation. It facilitates the visual dimension in the explorative and evaluative 'conversations' that are central to the design process. Linear perspective is an important representational system for design practice as it facilitates the capacity to think about and act on spatial dimensions. Learning to sketch in perspective can motivate and empower students in their design practice. For drawing education to extend beyond instructional teaching (how to draw) students need to be challenged to use drawing to research, explore and question. This requires that drawing education offers learning situations for both 'learning to draw' and 'drawing to learn'. Drawing to learn requires that students engage in the act of drawing before a clear vision has formed. Sketches can then become active agents in the 'conversation with the situation'.

A potential direction for further inquiry is the 'spatial verb'. A verb can help to shift the focus of learning from representing spatial objects to doing things with spatial objects. Enabling a shift in focus towards drawing as a design action. A spatial verb suggests a range of explorative possibilities; a line

can bend, join, encircle and cut, etc. A plane can be rounded, bent, divided. Solids, drawn in perspective can be extruded, twisted, stacked and stretched etc.

Architect teachers Anthoni di Mari and Nora Yoo have explored the potential of verbs in their teaching practice with positive results;

Using verbs as a design tool also reinforces the idea of design as an active and fluid process - one where the operations illustrate an evolution of changing volumetric configurations (di Mari and Yoo, 2013, p.10).

To encourage the dialogic potential of drawing, attention and time must be given to conversations with and about drawings. The task of the drawing teacher then shifts from instructional (showing how to do things), to guiding (assisting students along a path of discovery). For a dialogic process to occur the teacher cannot stand entrenched at the end of a learning path and require that students replicate his knowledge and skill. Meanings and values must be open for construction and reconstruction, this requires that methods are questioned, and this questioning needs to be valued. Beyond learning to draw, in the long term, a drawing *practice* is best facilitated by motivations and attitudes that encourage the practice of 'drawing to learn'. Both in drawing practice and in the reflective discussions about drawings, focus should be given to the following;

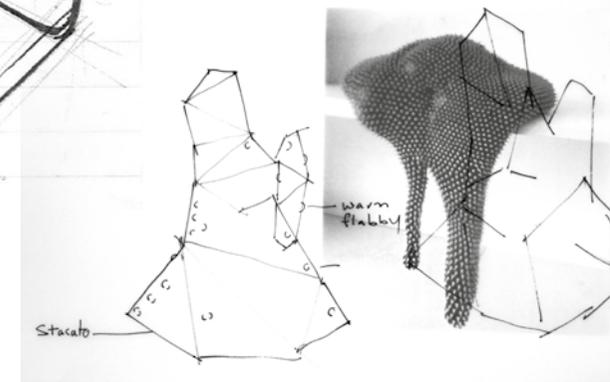
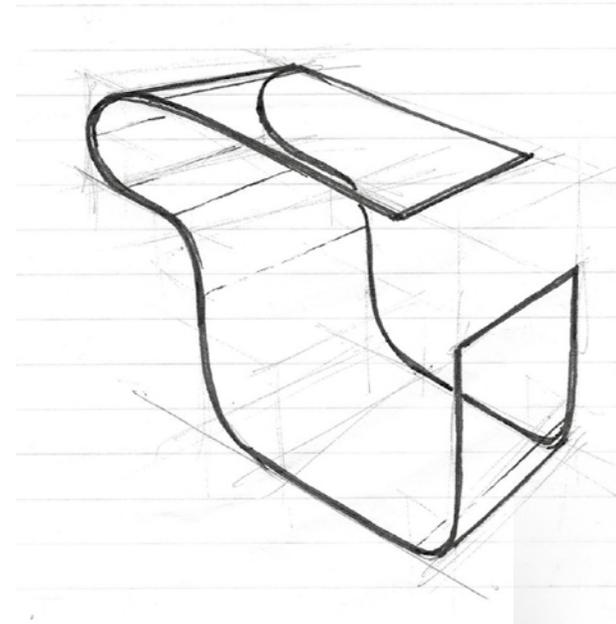
- Noticing (to generate conditions for an education of attention)
- Questioning methods (to encourage critical reflection)
- Cycles of drawing, reflection and drawing again (to encourage dialogic potential in drawing, being unfinished keeping the process open)
- Considering purpose, problem framing (actively forming, and directing own learning process, planning, asking what is the next step?)

Ensuring the time and space in a lesson program for sustained conversations about (and with) drawings is important. In classes of 30 it can be very difficult to facilitate the kind of sustained reflective discussions that guided discovery (or rediscovery) requires. Coaching sessions with regular meetings can offer a context for enriching dialogic practice between peers. Essential to explorative and dialogic learning is the space in a teaching practice for explorative experiments with students. Questioning methods and sharing responsibility for learning evokes a level of uncertainty. Deviating from tried and tested

routines might seem risky and inefficient, but without these experiments there can also be little learning in teaching. Of course, inherent to experiments is that they are prone to failure, a balance needs to be found. Education might learn from design practice and plan to learn from small failures iteratively in order to avoid larger ones.

As I finalize this thesis, in this last week of writing. I am acutely aware that other parts of my teaching practice might have been valuable inclusions in this thesis. I chose not to give them more focus because they occurred too late in the year, with assessment weeks after the thesis deadline. Drawing classes in a first-year subject Product and Form have offered the opportunity to explore the potential of drawing 'spatial verbs' further and explore the potential of drawing as research for design history concepts in sketchbook assignments. A small last workshop was given with a group of five students in the Minor, where I introduced tracing paper and we explored the potential of drawing in sustained group conversations. This might be a very promising direction for further research. While drawings explore abstract concepts, drawing in conversation connects well with the engineers and architects sketching practices. The sketches responded to a student's personal research question and evoked/suggested a means by which visual dimensions can be brought into conversation in a meaningful way. In quick sketches, interpretations of sound and word to form were explored collectively. This led to valuable new insights. Shapes were interpreted as active or passive, open or defensive. Questioning the sound of form and the form of sound associatively triggered new ideas and revealed interesting new patterns. Again, this project would have made a valuable case study in this research but emerged too late to include in a substantial way in this thesis.

Another point of attention is that the learning situations described do not engage with technical aspects of design challenges. This is a consequence of my decision to integrate research into my continuing teaching practice. Coming from an arts background I do not teach technical subjects. However, I am certain that the explorative and dialogic potential of drawing is just as relevant, perhaps even more so, when learning is focused on practical, material and technical questions. Conversations with engineer teachers strongly support this view (appendix B). A key point of learning across the curriculum is that to encourage the explorative and dialogic potential of sketching requires us to take sketches seriously and bring them into the



Drawings made during a group conversation on tracing paper as we explored sound and form ideas for a self-directed design project.

reflective conversations where learning takes place. This means, not just learning how to make drawings, but also how to learn from, and with, sketches. The visual language that sketching facilitates needs to be actively used by teachers and students. A dialogic process needs to be open to the construction and reconstruction of meanings and methods; to explore other arrangements, volumes, spaces, and values, by sketching, reflecting and then sketching again.

Valuing uncertainty

It is not a simple naïveté elevated. Rather it is making a space for uncertainty, for giving an impulse, an object, a material, the benefit of the doubt. Following the impulses that feel stupid, without destination, believing that at some point, we will emerge from our zoetrope (Kentrige, W. 2011, p. 128).

While students and institutions rightly expect a level of structure and clarity, uncertainty, being an inherent condition in any creative practice (and life in general) will logically also have to be part of education. Beyond memorizing facts, learning involves actively structuring and restructuring knowledge, methods, purposes and values. This is why we must be careful to not to evoke an experience of learning as simply a process of mastery and attainment. I would like to suggest that the way we come into learning is important because it shapes, not just what we come to know, but also *how* we continue to engage with learning far beyond the limits of any formal learning situation. Like novice learners, a teacher is also moving along a path of learning without an end. The art of teaching then involves generating conditions for a process of guided discovery (or rediscovery) that directs students towards experiences where knowledge and skills are grown, rather than given as fully specified ready-mades. For students, the process of attempting to form meaningful learning goals and structure their own explorative learning processes is key to both design and learning in general.

There is a need to tolerate and work with uncertainty, to have the confidence to conjecture and explore, to interact constructively with sketches and models, and to rely upon one's 'intuitive' powers of reflection-in-action (Cross, 2011, p.26).

Drawing practice can be a way to develop an attentive way of looking and a delicacy of touch. Learning to draw, is, for a great deal, a process of learning to see, it is an education in attention. This involves learning to notice, not only what things look like, but also anticipating where they are going. This kind of attention is also needed in education. By giving attention to a student's 'active line', found in personal fascinations, values and urgencies, we create

space for more personal and emancipatory pedagogies. As Paul Klee's 'line on a walk' reminds us, a learning line can be limited in its movement by externally specified and predetermined points or it can be actively (becoming) by freely choosing, or at least negotiating, its own trajectory. Learning is a process of absorbing the accumulated knowledge of a field of practice and giving shape to a personal path through it. In fact, in a fast changing 'liquid modern' context we might be best advised to conceive of any professional field of practice as a meshwork of personal paths, that woven together, form a living community of practice. Uncertainty, as an inherent quality of 'liquid modernity', design, learning, and life in general, is also key to transformational learning. The loose threads of a fast-changing world can never be fully articulated. Acknowledging this allows us to leave space in learning for students to shape meaningful goals beyond those defined by teachers. It also offers teachers the opportunity to listen and learn together with students. Long before the term 'life-long learning' had any educational currency John Dewey wrote that the challenge of a future oriented education was to acquaint students with the knowledge of the past; "in such a way that the acquaintance is a potent agent in appreciation of the living present" (Dewey, 2015, p. 23).

In a situation characterized by the uncertainty of continuous and unpredictable change, education that gives impetus to explorative and dialogic learning will help to foster the critical and creative attitudes we need to create a (more) hospitable present and future.

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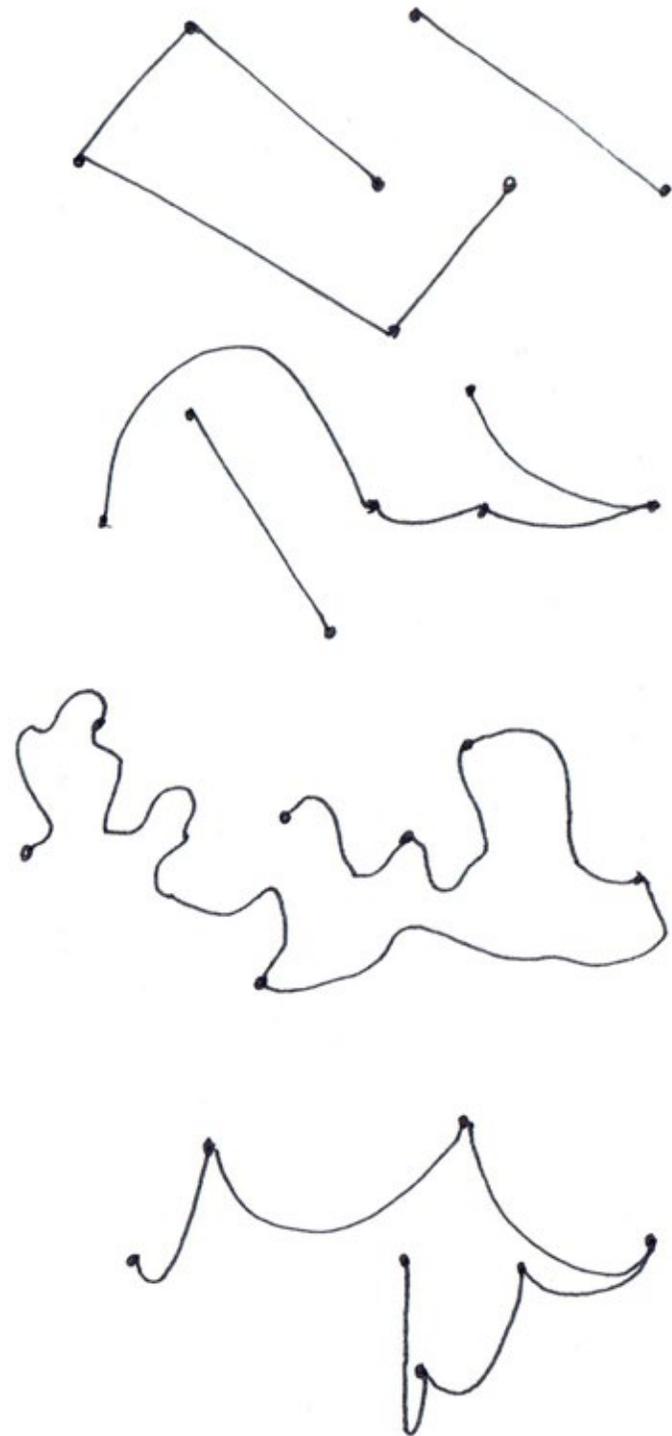
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APPENDIX A

Quotes from field notes and student reflective journals. Collaborative drawing

“Het helpt je verder komen als je vastloopt”

“Deze klas is al vertrouwd met elkaar, wij helpen elkaar graag”

“Je komt op meer ideeën door anderen”

“Het wordt gaandeweg makkelijker om meer ideeën te bedenken”

“Wij helpen elkaar graag, nu weet ik beter waar ze mee bezig zijn”

“Veel ideeën waren oppervlakkig maar er komen toch een paar goede ideeën uit”

Teachers comments

“De kwaliteit was niet hoog maar ze hadden plezier, het motiveert wel”

“Ik weet niet wat je doet, maar blijf het doen”

Esthetiek A – citaten uit student reflectieverslagen.

Naar mijn mening is dit een van de leukste vakken. Dit vak laat toe wat semiotiek mist, en dat is het aan de student bieden van een groter platform waarbinnen meer ruimte is voor persoonlijke smaak en ontwikkeling.

Ook al wist ik niet echt waar dit vak heen zou gaan. Uiteindelijk heb ik er toch een duidelijk beeld van gekregen en een doel op kunnen stellen. Twijfel bij alles wat je ziet en ga op onderzoek uit.

Wat ik nog graag even wil zeggen, is dat ik de laatste opdracht uiteindelijk heel leuk vond om te doen. De thema's die ik heb gekozen, houden me de laatste maanden al erg bezig en het is iets wat ik als ontwerper zeker wil meenemen in de toekomst. Ik ben er ook echt van overtuigd dat deze thema's grote rollen gaan spelen in de toekomst en als ontwerper hoop ik hier ook een extra zetje in te geven. Ik hoop mensen te inspireren om eerlijk te kijken en ethische keuzes te maken.

Ik vond het interessant om te zien dat iemand iets mooi kan vinden terwijl jijzelf het lelijk vind. Door meningen van andere te horen kun je zelf ook anders gaan kijken naar een object.

Door esthetiek ben ik anders gaan kijken naar objecten. Het heeft mij geleerd om te bedenken of ik iets nou mooi of lelijk vind en hoe dit kan.

Nu ik bezig ben met de eindopdracht ben ik me ook steeds meer gaan realiseren dat er alleen al bij een boekje goed nagedacht moet worden over wat je wilt overbrengen. Hierbij spelen veel factoren een rol waarover je eerst niet zo snel zou nadenken. De papierkeuze zegt bijvoorbeeld al erg veel. In eerste instantie zou ik hier niet zo lang over nadenken.

Het vak Esthetiek A is een vak dat me ligt en tegelijkertijd niet ligt. Het voelt heel zweverig, maar ook gebaseerd op feiten. Dit was dan ook wel het punt waar ik moeite mee had.

Het schetsen vond ik leuk om te doen je gaat daardoor toch anders naar een object kijken. Het was ook grappig om te zien dat ik vrijwel altijd kon zeggen en schetsen wat ik mooi vond, maar niet per se kon zeggen en/of schetsen waarom ik iets niet mooi vond. Het vak is erg leerzaam en laat je (weer) anders kijken naar objecten.

De combinatie die tijdens dit vak werd gemaakt met tekenen vond ik erg prettig. Door andere tekenstijlen aan te nemen en daarmee verschillende gevoelens of gedachten uit te beelden sprak mij erg aan. Tijdens het eerste jaar van de opleiding kregen wij geleerd om op een bepaalde manier te schetsen. Bij Esthetiek was het echter niet de bedoeling dat je op deze manier zou schetsen, dat vond ik erg prettig aangezien er meerdere manieren zijn om middels schetsen ideeën over te brengen.

Tijdens de lessen waren geregeld hevige discussies die bijdroegen aan het creëren van een eigen mening. Ik heb dat zelf al erg behulpzaam ervaren, omdat ik vaak moeite heb om mijn eigen mening ergens over te vormen en te verkondigen. Doordat we ditmaal in groepsverband discussieerde vond ik het makkelijker mijn stem te laten horen en ook daadwerkelijk in discussie te gaan met mijn studiegenoten.

Ik heb veel geleerd tijdens deze lessen. Vele verschillende meningen en interpretatie van beelden, onderwerpen en principes. Ik heb geleerd om ook anders te gaan kijken naar kunstwerken en ontwerpen. Esthetiek is heel persoonlijk en dan door verschillende dingen worden beïnvloed, zoals het verhaal erachter, het omgeving en de stemming die je op dat moment hebt. Daarom is niks goed of fout.

Dingen die ik anders zou willen doen; Schetsen, ook al weet ik niet wat er gescheten moet worden. Niet meer uitstellen met schetsen

Wat ik erg leerzaam vond aan dit vak is dat het verhaal van andere studenten over waarom ze nou een product aantrekkelijk vinden hoort. Dit is voor mij het belangrijkste aspect aan het vak geweest, aangezien het me deed beseffen hoe belangrijk context bij een product is.

Tijdens dit vak heb ik geleerd om dingen die je normaal op gevoel deed, te analyseren. De eindopdracht vind ik wel lastig, ik ben nog steeds op zoek naar hoe ik het precies wil gaan doen. Omdat het een persoonlijk document moet worden en ik erg geïnteresseerd ben in

mensen en hun identiteit, wil ik het boekje gaan maken aan de hand van persona's. Ik kies ongeveer 3 personen en probeer te visualiseren hoe hun leven eruit komt te zien in 'possible futures'.

Ik merk dat ik daar nog wel veel aan moet werken om het creatieve proces op gang te laten komen. Ik denk dat het voor het boekje ook belangrijk is om stalen van materialen te gebruiken omdat hierdoor de persona's echt tot leven komen.

Anders naar producten en dingen om me heen gaan kijken. En dan vooral met de vraag: Waarom? Waarom ziet dat er zo uit? Ik vind dat soort vragen leuk om te stellen aan mezelf, het geeft je weer een andere kijk op dingen dan dat je normaal zou hebben. Wat de grootste indruk op mij heeft achtergelaten zijn de 4 principes, vooral 'Maximum for minimum means'. Omdat ik dat op heel veel dingen kan toepassen en merk dat dat zo gebeurt om me heen. Het vak houdt me telkens bezig ook buiten school om en dat vind ik er zo interessant aan. Ik vind het een leuk vak en vind dat er meer tijd of vaker les in mag worden gegeven.

Esthetiek gaat over de schoonheid. Iedereen heeft daar weer andere meningen over.

Door zelf een camera te pakken en van zo veel mogelijk dingen een foto te maken kom ik er al snel achter dat alles wel een bepaalde schoonheid bevat.

In dit vak heb ik geleerd om dus anders naar voorwerpen te gaan kijken. "Mooi en lelijk" gebruik ik niet snel meer om iets te omschrijven. Om echt een indruk te geven van wat je vindt, moet er meer diepgang in zitten, vind ik.

Het vak esthetiek is voor mij een andere manier omgaan met creativiteit dan we normaal gewend zijn. Producten zijn anders te ontwerpen dan het ontwerpen voor dit vak.

Mocht dit vak nog een keer gegeven worden, zou het misschien wel leuk zijn om langere lessen in te delen zodat je echt met elkaar kan nadenken en discussiëren over esthetiek. Het is toch echt wel een onderwerp dat een beetje op gang moet komen en het is jammer dat daar een limiet van 50 minuten aan zit.

Esthetiek A heb ik als heel leerzaam ervaren. In het begin zag ik er best tegenop omdat ik dacht dat het vak zou zijn dat 'zweverig' was en dus niet een leuk vak voor mij. Achteraf vond ik het erg leuk en vooral leerzaam. Je mocht eindelijk zelf bepalen wat je wilde opleveren.

Het steeds een tekening moeten maken vind ik goed. Zo ben je net wat langer bezig met nadenken, en moet een beetje creatief blijven. Je past toe waar je net over nagedacht hebt, of het nou mooi getekend is of niet.

Ik vond het interessant om op een hele subjectieve manier naar beelden en objecten te kijken. Hierdoor leerde ik meer hoe ik mijn eigen mening over beelden onder woorden kon brengen.

In het begin vond ik het vak raar en vaag. Ik wist niet zo goed wat ik moest schetsen omdat ik al foto's had gemaakt. Daardoor snapte ik de opdrachten niet echt. Ook snapte ik niet hoe ik door schetsen de essentie duidelijk kan laten zien. Later werd het iets duidelijker maar het blijft zweverig. De eindopdracht vond ik heel leuk om te doen. Ik had gelijk veel ideeën en zin om te beginnen. ... Ik van het heel fijn dat we onze eigen ding mochten doen. We werden vrijgelaten in onze creativiteit, en dat vond ik heel fijn!

MINOR –workshops - The essentie van ontwerpen

Ik ben redelijk zelfverzekerd over hoe ik teken. Mijn tekeningen behalen altijd het doel wat ik ermee wil bereiken. Ik heb mijn hele leven al getekend, maar ik kan niet per se een moment vastleggen dat ik er zelfverzekerd over werd. Ik werd gewoon beter naarmate de jaren vorderden

Ik voel mij pas gemotiveerd om te tekenen als ik een bepaald doel heb voor de tekening.

Het voordeel van mijn tekenkwaliteiten is dat het ruimtelijk kan vastleggen en de kwaliteit kan vastleggen. Dit dus via het ambacht van het tekenen, waar anderen dit vaak met Photoshop doen. Ik zie hier een voordeel in om dat echt tekenen schaars is in mijn vakgebied (stedenbouw).

Ik vond het leuk om te experimenteren met nieuwe materialen. Omdat ik al wist waarmee ik goed/fijn kan tekenen was ook niet geneigd om andere materialen te gebruiken. Echter, nu weet ik dat andere materialen een ander gevoel in mijn tekening kunnen stoppen.

Een opmerking die ik zou kunnen geven is dat de lessen wel wat meer structuur zouden kunnen krijgen. In de laatste les zag je op een gegeven moment mensen die compleet iets anders gingen doen omdat ze klaar waren met nieuwe vormen proberen te maken.

Wat ik goed vond aan de lessen is dat we zelf mochten aangeven wat we wouden leren.

Tekenen is een middel dat ik vooral inzet om ideeën naar anderen te communiceren en van m'n hoofd naar het papier te krijgen. In het zoekende ontwerp aspect gebruik ik op school nooit het tekenen, maar ruimtelijke materialen.

Ondanks dat er voor mijn tekenvaardigheden veel ruimte voor verbetering ligt ben ik zelfverzekerd over het op simpele wijze communiceren van een idee in m'n tekeningen.

Met schetsen wordt je nog niet geconfronteerd met ruimtelijke vormen en haalbaarheid, dat is positief. Daar schuilen veel creatief vernieuwende inspirerende mogelijkheden in.

Een voordeel van het propedeuse jaar tekenonderwijs: je leert ruimtelijke vormen schetsen en volumes en materialen communiceren. Nadeel: deze technieken communiceren veelal vanuit de gedachte van

wat er al op de markt is. Deze wijze levert totaal geen vernieuwing en eigenheid op.

Wat mij verraste is dat het (de workshops) dieper inging op het persoonlijke proces dan ik verwachtte.

De sfeer was voor mij voornamelijk prettig in de kleine groep van 5 personen

Met zelfgekozen materialen aan de slag als rode lipstick werkte voor mij. Met houtskool niet. Wat ook heel goed voor mij werkte was het in tekening onderzoeken van vormen en texturen, waaronder Kiki en Bouba. Optimistische vormen met contrasterende texturen.

Ik wil graag beginnen door aan te geven dat ik heel tevreden was over de inhoud van de les afgelopen woensdag. Vooral de eerste oefening met houtskool vond ik heel inspirerend en een goede oefening om inzicht te verkrijgen in de verhouding tussen lijndikte en de diepte, dynamiek en "energie" van een schets.

Ook vond ik het heel fijn dat jij je onderzoek toelichtte in een klein college, dit was informatief maar ook qua kennismaking was dit fijn. Dat je van tevoren aangaf hoe je de lessen wilde geven (samen experimenteren met materialen en technieken en zo interessante combinaties ontdekken) vond ik prettig en kwam volgens mij ook positief binnen bij de groep.

Ik moet hierbij wel aangeven dat er door deze methode op sommige methoden net te lang werd getwijfeld over de volgende stap. Jij bent de docent en daarom mag je van mij op sommige momenten sneller een knoop doorhakken. Die sturing biedt altijd wel een prettig houvast. Om terug te grijpen op de eerste opdracht bijvoorbeeld: het was duidelijk wat er van ons verwacht werd en ervaaarde het naderhand samenkomen en reflecteren op het werk van de groep ook als een fijn aspect.

Ook het schetsen van het persoonlijke voorwerp was leuk om te doen en openbarend in de zin dat er zoveel mogelijkheden zijn om hetzelfde object weer te geven. Dit was inzicht gevend, misschien is het ook hierbij leuk om naderhand iedereen zijn werk neer te laten leggen of op te laten hangen en dan met de groep te reflecteren op de gevonden mogelijkheden/ ontdekkingen.

De laatste opdracht was luchtig en leuk op sociaal gebied, maar niet heel leerzaam.

Mijn enige tip is eigenlijk: neem op overgangsmomenten sneller een beslissing en durf deze ook te maken voor de groep.

Ik ben a.d.h.v. de workshops wat zelfverzekerder geworden in mijn tekenvaardigheid. Ik merk dat het meer om de content van een tekening gaat dan de kwaliteit hiervan. Op IPO Den Haag is het altijd belangrijk geweest dat de schetsen zo accuraat als mogelijk zijn, maar door een wat lossere aanpak aan te leren kan ik prettiger werken.

Ik heb uitsluitend schets les gehad op IPO, ik vond het fijn dat dit gebeurde vanaf de basis. Ik heb hierdoor opnieuw moeten leren kijken naar tekenen, en ik ben waarschijnlijk een deel van mijn eigen creatieve invulling kwijtgeraakt, maar ik ben wel in staat een duidelijke schets neer te zetten op elk gegeven moment. De skill is erg constant geworden waar als dat vroeger het afhing van de inspiratie op dat moment.

- Ik heb de workshops fijn ervaren. Er hing altijd een lichte sfeer waardoor de creativiteit makkelijk vloeiende. Wel moet ik aangeven dat de lessen af en toe iets meer sturing kunnen gebruiken.

- Ik vond de houtskool atoomkern tekensessie heel waardevol. Ik heb ervan geleerd kritischer te kijken naar lijndikte en ik ben aan het oefenen met dynamischer schetsen. Voordat ik aan de lessen begon draaide ik altijd het papier om mijn lijnen recht te kunnen zetten. Nu probeer ik het papier te laten liggen en mijn lijnen in alle hoeken recht te krijgen.

APPENDIX B

A conversation with two design engineer teachers.
Location: Amsterdam University of Applied Sciences
Amstel campus, Weesperzijde 190, 1097 DZ Amsterdam – 14:00
20/01/2016

(only a part of the conversation has been transcribed - a complete recording can be supplied on request).

J: je hebt zo veel stadia van kwaliteit van schetsen... Ik vind zelf dat het biervilt schetsje, de kwaliteit van het biervilt schetsje, waar het ook vaak mee begint, zoals ze hier neerzetten, die kan volgens mij omhoog, op de een of andere manier.

R: een biervilt schets maak je als je dronken bent, daarom is het een biervilt schets.

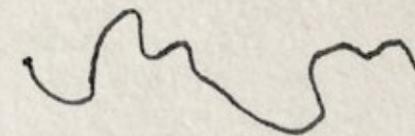
J: Nee, nee, niet omdat je dronken bent, maar omdat je heel snel je idee wilt vastleggen, dus dan pak je maar dat bierviltje.

J: Jan had het laatst over een potlood-cultuur dat ze, bewijs van spreken, door de zaal lopen met een potlood achter hun oor.

R: ... maar als je het tekent, kan je dan lekker mee rondingen van maken, het proberen, om te zien of het misschien leuker aan kan sluiten, misschien kan dit ook rond... (wijzend naar schets).

R: Ik wil graag dat ze tekenen omdat dan weet ik dat ze het begrijpen.

J: terwijl ik mijn pen op papier zet weet ik nog niet hoe het in elkaar zit, zo werk ik dan... Ik kom pas tot de oplossing terwijl ik teken. Je laat de pen voor je denken, zo moet het zijn.



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