Merja L. M. Bauters*

Experience in Design and Learning Approaches – Enhancing the Framework for Experience

Abstract

In design and learning studies, an increasing amount of attention has been paid to experience. Many design approaches relate experience to embodiment and phenomenology. The growth in the number of applications that use the Internet of Things (IoT) has shifted human interactions from mobile devices and computers to tangible, material things. In education, the pressure to learn and update skills and knowledge, especially in work environments, has underlined the challenge of understanding how workers learn from reflection while working. These directions have been fuelled by research findings in the neurosciences, embodied cognition, the extended phenomenological–cognitive system and the role of emotions in decision-making and meaning making. The perspective on experience in different disciplines varies, and the aim is often to categorise experience. These approaches provide a worthwhile view of the importance of experience in learning and design, such as the recent emphasis on conceptual and epistemological knowledge creation. In pragmatism, experience plays a considerable role in research, art, communication and reflection. Therefore, I rely on Peirce’s communicative theory of signs and Dewey’s philosophy of experience to examine how experience is connected to reflection and therefore how it is necessarily tangible.

Keywords: experience; qualitative immediacy; common ground; reflection; habit change.

Introduction

The need to reconsider design and learning emerged from the increasing use of mobiles, wearables and ideas related to the Internet of Things (IoT) or the Internet of Everything (IoE). A common emphasis has been on re-evaluating and structuring human interactions in environments that require sense-making processes (e.g., activity theory, see Kaptelinin & Nardi, 2012). In learning, other specific needs have been considered, such as the pressure to re-learn and to update skills and knowledge, especially in work environments (e.g., Eraut, 2000, 2004; FitzGerald, 2012; Oppermann & Specht, 2006; Welsh, Wanberg, Brown, & Simmering, 2003). This research has underlined the challenge of understanding how workers learn from experience and how they reflect while working. These changes have been fuelled by findings in the neurosciences, embodied cognition (Shapiro, 2014; Clark, 2003), the extended phenomenological–cognitive system (Silberstein & Chemero, 2012), as well as the deep role of feel-

* University of Helsinki, Finland. E-mail: merja.bauters@helsinki.fi.

ings and emotions in decision-making and meaning making in conscious activities (Hassenzahl, 2010; Damasio, 2001; Norman, 2004). Different disciplines provide worthwhile but varied views of the importance of experience in learning and design. However, only a few studies have focussed in depth on previous discourses on experience, such as pragmatism. The point I want to make is that it is not possible to overlook the tangibility of learning and meaning making. In this article, I challenge the Cartesian view. I also consider that the embodied aspects of learning and meaning making should be taken seriously. I describe the learning process from the perspective of the extended phenomenological–cognitive system because both phenomenology and the cognitive sciences are based on pragmatism. The contribution of this article is that it combines Dewey’s two types of experiences, which are present in his reflection cycle, and Peirce’s phaneroscopic categories, which emphasise doubt and collateral experience. Experience is seen from two perspectives: non-reflective experience is based on habit as a dominant form of experience; and reflective experience, which is mediated by intelligence and knowledge, and which grows from the inadequacy and contradictions of habitual experience and ways of action. Understanding experience sheds light on the roles of the environment and interactions in environments, as well as the role that feeling while acting has in reflection and in meaning making. I will first briefly describe the main design approaches that take into account experience. Next, I will discuss the current approaches to human learning that combine experience with reflection. Finally, I will combine the approaches because in order to support and enhance the potential to learn and reflect, tools and environment need to be designed differently. My claim is that in designing tools for learning the focus should be on aiding the process of human reflection, not on removing reflection from the process, which most currently used tools tend to do.

Design and Experience

In design research, the idea of experience, namely user experience, has been present since the interest in usability was first raised (Wright & McCarthy, 2010). However, this view has been vague, reduced and fragmented, and it has related more to methods than to providing a framework for design. In addition, in practice, experience is rarely taken into account in design, and the understanding of the meaning of experience for design varies greatly. Wright and McCarthy (2010) described a qualitative and interpretive approach to experience-based design, designing for experience, user experience design, or “experience-centred design”. Wright and McCarthy (2010) reviewed the history of using experience in design, thus supporting their own framework for experience-centred design. During the 1990s, the idea of understanding users in design included the user’s experience in a particular context. Updated methods for investigating and understanding work practices were introduced, such as Suchman’s (1987) situated action theory and Nardi’s (1996) activity theory. Because it is value laden and democratic, participatory design focuses on users and their experience, thus empowering workers to design their work. This approach is also called the Scandinavian participatory design approach (Greenbaum & Kyng, 1991; Ehn, 1988; Bødker, 1996). Scandinavian participatory design is rooted in post-war political movements that strived for industrial democracy. It included forms of co-determination by unions and “shop floor” workers to enhance decision-making and the quality of work life. The aim of participatory design is to increase democracy in the workplace by giving the members of organisations the right to

participate in decisions that would affect their work. According to Ehn (1993), participatory design is considered in the interests of emancipation, and a deliberate choice was to side with workers and their organisations in order to support the development of their resources in achieving democracy in the workplace.

Participatory design emphasises the changing of artefacts, people, organisations and communities. Such changes require the ability to envision future usage, new tools and transformed infrastructures and interactions. Participatory design requires that users are included in the design process, even as co-designers. The values that exist in social settings are included because the values that are implicit (tacit) and explicit in imagined future practices make a difference in the design. Taking into account these values enhances trust, reciprocity and mutual learning in working relationships (Gregory, 2003).

Cartesian models of cognition were challenged by Winograd and Flores (1988) in their book, *Understanding Computers and Cognition: A New Foundation for Design*. Dourish (2001) relied on phenomenology to formulate the idea of embodiment in emphasising the physical and social context and the interaction with artefacts and people in a situation. Norman (2004) set forth the idea of emotions in his book, *Emotional Design*. There is no correct way to categorise or summarise these approaches. One could emphasise different aspects of the design approaches, such as by using participatory design as an umbrella concept in design research. Hence, in many of the above-mentioned approaches would be included participatory design (e.g., Spinuzzi, 2005). Forlizzi and Battarbee (2004) stressed that the role of experience varies in the design disciplines and that the authors of the various approaches categorise experiences in different ways. According to Forlizzi and Battarbee (2004), multidisciplinary teams should use the most suitable methods to select frameworks of user experience. Table 1 presents categories of the types of experience and the methods used by the authors discussed above.

Table 1. Various Categories of Experience.

<i>Types of experience</i>	<i>Description</i>	<i>Types of user product interaction</i>	<i>Examples</i>
Experience	Reflective experience	Cognitive, reflection at hand	Figuring out how something works, e.g., odd toilet in foreign country
An experience	Non-reflective experience based on habits	Fluent	Riding a bike
Co-experience	Shared experiences	Expressive, joint meaning creation	Creating a Prezi presentation together

Source. Forlizzi and Battarbee (2004, p. 263)

In Table 1, the perspectives on experiences are modified to fit the two types of experiences described by Dewey in relation to the types of user–product interactions. types. However, the different experiences are based on main emotions, such as joy, frustration, annoyance and so on.

Only a few previous studies have investigated systematically the benefits of pragmatism although their foundations are non-Cartesian.¹ Because design is rightfully related to educa-

tion and learning, in the next section, I will introduce some learning approaches and theories in which experience plays an important role.

Learning Approaches in Which Experience Plays an Important Role

Kolb's ideas have been frequently mentioned in discussions of experience and learning particularly in the field of adult education and organisational learning. I will first briefly discuss problems in Kolb's approach. Although these problems are well known, they are not referred to in recent research.² Moreover, few studies have conducted critical analyses of Kolb's work. Miettinen (2000) pointed out that Kolb's quotations about and descriptions of experience and learning from experience and reflection provide a misleading perspective on Dewey's work and thought. In his experiential learning theory, Kolb (1984) described the learning circle as consisting of the following steps: (a) concrete experience, (b) surveying and reflection on the experience, (c) forming abstract concepts and (d) active experimentation with newly acquired knowledge. Kolb regarded learning as a process in which knowledge is created by transforming experience through these four steps (Kolb, 1984, p. 41 cited in Beckman & Barry, 2007, pp. 28–29). The problem is that the approach combines multiple theories to construct the experiential learning theory such that the theories conflict. John Dewey, Kurt Lewin and Jean Piaget are considered the founding fathers and developers of Kolb's approach. Other approaches and thinkers that influenced Kolb's writing include therapeutic psychologies based on psychoanalysis (Carl Jung and Erik Erikson) and humanistic psychology (Carl Rogers and Abraham Maslow) as well as radical educationists such as Paulo Freire and Ivan Illich. Kolb also utilised the results of research in neurophysiology, which reported the functional differences between the right and left hemispheres of the human cortex. Kolb used the results of research that applied the theory of world models presented by the American philosopher Stephen Pepper. Kolb united terms and concepts that were extracted from their idea–historical contexts and purposes. His approach is not critical or interdisciplinary but the construction of an attractive collection of ideas that substantiate the usefulness of Kolb's learning style inventory (Miettinen, 2000, p. 56). Miettinen explained thoroughly how the eclectic combining of parts of theories and concepts without relating them to their historical background results in theoretical and epistemological inadequacy (2000, p. 61). Contrary to Kolb's attempt, Dewey resolved the relationship and tension between experience and reflection by distinguishing between the non-reflective experience and reflective experience. Non-reflective experience is based on habit as a dominant form of experience and reflective experience is mediated by intelligence and knowledge, and it grows from the inadequacy and contradictions of the habitual experience (Miettinen, 2000, p. 62).

Dewey's model of reflective thought is central in current learning approaches, some of which are inquiry-based learning, problem-based learning and progressive inquiry (PI-Model). In addition to Dewey's influence, their antecedents are in constructivist learning theories, such as the works of Piaget and Vygotsky. Recent thought in education relies on the cognitive research in educational practices, and it is closely associated with Carl Bereiter and Marlene Scardamalia's (1993) knowledge-building approach and Jaakko Hintikka's (1999) interrogative model of inquiry. Furthermore, the metaphor of knowledge building and knowledge creation (i.e., dialogical learning; Paavola & Hakkarainen, 2005) is based on Bereiter's thought, which emphasises the collaborative process of advancing and creating knowledge.

The approach draws on Popper's (1981) distinctions between physical reality (World 1), the mental world (World 2) and the cultural world (World 3), as well as on Peirce's notions of mediation, which emphasise working in a sustained manner using shared artefacts that are developed in collaboration. It emphasises that consciousness is mediated by artefacts, tools and signs (Vygotsky, 1978). These approaches underline the collaborative work on shared artefacts through which knowledge creation occurs.

The common issues that emerge from the above approaches are as follows:

- Collaborative work, bringing forward the social aspect of experience and sharing of experiences;
- Combined use of material and conceptual artefacts;
- Acting in an context/environment–situatedness;
- Reflection triggered by problems, challenges and doubt.

The aspects of collaborative work, the intertwined nature of the materiality of concepts, the situatedness and reflection triggered by doubt are connected to the understanding of the role of experience in design and learning, which are the focus of the present article. I attempt to show how acting in the context with material artefacts allows reflection that is triggered by doubt, that is, the feeling that “something is not right” or “something is odd”. The two types of experience described above are key in understanding how experience is used in action reflection. I will show how doubt provokes reflection through a moment of “halt”, and I will situate the Peircean notion of doubt into Dewey's reflection process. I will begin by explaining the role of experience in pragmatism before examining Dewey's reflection process.

On Pragmatism, Dewey and Peirce

In pragmatism, the role and form of experience in research, art, communication and reflection is relevant for design and learning. The increasing interest in experience is considered as well as the connections between Dewey and Peirce (on experience and education, see Stables, 2008; Olteanu, 2015, 2015). In the social sciences, education and user experience design, pragmatism is increasingly emphasised. For example, in 2015, *The European Journal of Pragmatism and American Philosophy* published a special issue called *The Pragmatist Method: New Challenges for the Social and Human Sciences*. Another example is the Interaction Design Education Summit 2016³ Conference where pragmatism, specifically in Dewey's thought, was presented as a central theory. In short, experience was emphasised. Experience has been seen both to promote reflection and to emerge in reflection (Beck, 2015; Baltes & Staudinger, 2000). Two types of experience can be distinguished in Dewey's writings: 1) experience that is felt, thought and perceived; and 2) experience that is formed through reflection. The problems and dynamics of life activity pertain to both habitual non-reflective experience (1) and reflective experience (2). Although neither the recent conference, nor the special issue on the pragmatist method explicitly connected the ideas of Peirce and Dewey, it is not misleading to state that Peirce's thought motivated Dewey (see Philström, 2004; Innis, 2004; Brenstein, 1961; Kilpinen, 2000; Dewey, 1946). According to Philström, Dewey's 1923 essay, “The pragmatism of Peirce”, which supplemented Peirce's *Chance, Love and Logic*, provides one of the best insights into Dewey's understanding of Peirce. Despite the often-mentioned connections to James, Philström explains that Peirce and Dewey were clos-

er in some aspects of their thought than Dewey was to James, such as in favouring the dynamics of science rather than structures (see Dewey, 1946, pp. 156–157). In short, it could be said that Dewey had a tendency to psychologize his principles of scientific inference. For Peirce, Dewey attempted to describe a “natural history” of experience, and pragmatism was a method for clarifying ideas and a maxim of logic (Philström, 2004, p. 43). Philström explained that it was possible to see that Dewey continued some Peircean ideas, such as the reflexivity of habit of action and rationality (see Kilpinen, 2000). An important issue is that Dewey did not completely reject Peirce’s realism of generality (Philström, 2004, p. 43). Dewey (1946, p. 228) acknowledged Peirce’s emphasis on habits, in which the generic propositions of the universals of science take effect only through the medium of habit. Philström (2004, p. 43) added that one difference between Peirce and Dewey is that Dewey saw science as “socially responsible” rather than purely science. Dewey’s approach was constructivist with regard to his view that the actions of inquirers were aimed at building knowledge (see Shook, 2000). (On the relation of social constructivism and trialogical learning, see Hakkarainen & Paavola, 2005.). However, if Peirce’s theory of signs is viewed from the perspective of communication (Bergman, 2005, 2013), it is possible to find similar social and collaborative stances, which is emphasised in trialogical learning. The connections between Peirce and Dewey provide the basis for my approach, in which Peirce’s phaneroscopic categories of Firstness, Secondness and Thirdness exemplify the role of experiences, doubt and common ground in the first phases of Dewey’s reflection process. Hence, the emphasis is on experience and reflection triggered by doubt.

Reflection as a Process

Dewey’s understanding of experience is generally better known and more frequently used in design and learning studies than are Peirce’s ideas on reflection and experience. Therefore, I first discuss experience as a cyclic process. Experiencing is the active interaction that being has with the environment. The constant interaction changes being, and being changes the environment. In Dewey’s *Late Works* ([EN] pp. 13–14), he explains that experience stretches: it is neither static nor stable; instead, it stands in the relations between all things in physical and social environments. For Dewey, the experience is not something that happens inside the subject; it is not something from which the subject forms representations of the things in the environment. It is a continuous interaction with the environment, in which the “inside and outside” are not separate but form a unified whole (Dewey, LW 12 [LTI], pp. 73–74.) The interaction changes the environment as well as the awareness, experience and meaning of the environment. Thus, as the extended phenomenological–cognitive system assumes, our brain, body and niche are coupled in a non-linear manner. The term niche originates from biology, where niche is organism’s ecological role and way of life. Shortly defined, niche is an imaginary hypervolume whose axes correspond to several ecological factors affecting the welfare of the organism (Hoffmeyer, 2008). Current on-going experiences are scoped by past experiences in the same way that Peirce’s collateral experience can be understood. Therefore, existing habits, tools, institutions and mediating artefacts affect the current situation in which experience occurs as “qualitative immediacy”. However, the past makes a difference in attention in terms of where the focus will be and how the experience forms meaning. Felt ex-

periences are not impressions; they are real even though they are hallucinations because they are felt as real (Dewey, MW 9 [DE], pp. 16-21; MW 12 [RP], p. 133; LW 12 [LTI], p. 52).

Dewey distinguished between two kinds of experience, which however are intertwined. In *Experience and Nature* Experience, Dewey expresses that experience is composed of a material interaction with the physical and social environment and consists of “[O]bjects to be treated, used, acted upon and with, enjoyed and endured, even more than things to be known. They are things had before they are things cognized” (LW 1, p. 28).

The second form of experience is reflective and perceives the environment and its things as objects of reflection and knowledge: “The secondary experience is a reflective experience that makes the environment and its things as objects of reflection and knowledge. It is the failure and uncertainty of the primary experience that gives rise to reflective thought and learning” (LW 1, p. 28).

The responses of doubt or uncertainty to an experience give rise to reflective thought and learning, thus promoting a change in habit, in other words, a change of practice. Following Peirce, Dewey considered that people are guided by their sets of experiences (habits). We direct our attention and act based on our experiences. Such awareness widens the perception of “unusual” details and cues, which provide new insights, allowing the perceiver to be flexible enough to change habits, which are value laden (Dewey, MW 14 [HNC], pp. 16-33; LW 2 [PP], pp. 334-338; LW 7 [E], pp. 169-174, p. 185). In his *Middle works*, Dewey formulated the following:

Habits are conditions of intellectual efficiency. They operate in two ways upon intellect. Obviously they restrict its reach, they fix its boundaries. They are blinders that confine the eyes of mind to the road ahead. They prevent thought from straying away from its imminent occupation to a landscape more varied and picturesque but irrelevant to practice [...]. Habit is however more than restriction of thought. Habits become negative limits because they are first positive agencies. The more numerous our habits the wider field of possible observations and foretelling. The more flexible they are, the more refined is perception in its discrimination and the more delicate the presentation evoked by imagination. (MW 14 [HNC], p. 122)

This passage expresses the potential to consider the two experiences in relation to Peirce’s phaneroscopic categories. The experience with material interaction (1) relates to Firstness: “qualitative immediacy” occurs in Firstness, not forgetting Secondness as establishing the interaction within environment. The second experience (2) Miettinen terms secondary experience, (1) being the primary, relates to Peirce’s conception of Thirdness, which includes reflection and habit change. I will discuss these forms of experience using Dewey’s cycle of reflective thought and action (see Figure 1).

Figure 1. Presentation of Dewey's model by matching Peirce's phaneroscopic categories into first three steps on the reflective thought and action cycle.

Figure 1 present a modified model of Miettinen's (2000, pp. 65–70) explanation of Dewey's model of reflective thought and action. The modified model maps Peirce's phaneroscopic categories to the stages in Dewey's cycle. I will focus on the openings that connect both thinkers to the current discourse on embodiment and the extended phenomenological–cognitive system based on the assumption that experience is a process.

From Firstness to Thirdness

Peirce's concept of doubt is related to investigation, that is, to the scientific process. It is the force that starts and drives the inquiry: "[R]eal inquiry cannot begin until a state of real doubt arises" (Peirce, CP 6.474, see also Peirce, CP 7.78 and Peirce, CP 7.324). Despite this emphasis on inquiry, Peirce describes how doubt feels in order to distinguish, for example, between real doubt and doubting only for the sake of doubt (Peirce, CP 7.322 and CP 7.313): "Doubt is a certain kind of feeling. It has not only grades of intensity, but also varieties of quality" (Peirce, CP 7.109). In the grades of intensity, we find the threshold of the levels of consciousness, was explained by Telkänranta (2015). Namely, the first level of cognitive consciousness emerges from the fact that an animal knows when it is in pain, which is called emotional awareness. It could be assumed that this is the moment when Firstness aspires to Thirdness: it is not yet there, but it is a journey toward reflective thinking. The second level is cognitive awareness, which is the ability of perception, reasoning and insights based on the perception; the third level is self-awareness, and the fourth level is awareness of the awareness, that is, metacognition, which the ability to estimate one's own understanding. All these levels have been found in animals (see Telkänranta (2015).

Doubt is something that pauses an experience (1), where the expectation, which is based on the habit, turns out differently, and the emotion of surprise occurs (Peirce, CP 8.270). This pause creates irritation, annoyance, suspicion and the feeling that something is not as it should

be. The feeling is not graspable: one has to think and try to locate what it is that causes the feeling, which correspond to stages (1) and (2) in Figure 1 and the phaneroscopic category of Firstness. It triggers the process of reasoning and reflection. However, before reflection occurs, there is wavering: what if or “What can it be” (Peirce, CP 8.270). Doubt forces the subject to pay attention to the environment, to find a reason for the pause. Dewey’s cycle begins with uncertainty, disturbance and habit, which do not work, that is, it starts with doubt and wavering. The feeling of doubt is marked by the feeling of quality: to distinguish and name it moves the process toward Thirdness. However, Firstness provides the potential to become consciously aware of the feeling albeit irritatingly so. Firstness, according to Peirce, is composed of the feeling of qualities:

The typical ideas of Firstness are qualities of feeling, or mere appearances. [...] You think of it as a degree of disturbance of your consciousness [...] If you ask a mineralogist what hardness is, he will say that it is what one predicates of a body that one cannot scratch with a knife. But a simple person will think of hardness as a simple positive possibility the realization of which causes a body to be like a flint. That idea of hardness is an idea of Firstness. The unanalyzed total impression made by any manifold not thought of as actual fact, but simply as a quality, as simple positive possibility of appearance, is an idea of Firstness. Notice the naïveté of Firstness. (Peirce, CP 8.329, see also CP 8.328).

Firstness is also a potential: “That is to say, it is a possibility” (Peirce, CP 1.527). It could be said that ideas manifest in the feeling of quality, that is, qualitative immediacy. Bernstein defined Dewey’s meaning of the quality in experience and its relation to Peirce. According to Bernstein (1961, pp. 6–7), three points can be distinguished regarding the immediacy of experience: The first point is that the quality is not directly known (as stated by Peirce), which means that one cannot have immediate, non-inferential, logically indubitable knowledge of the quality. Qualities are directly felt or had. As stated above, to know means to reflect, name, classify, or connect the quality to something. Bernstein (1961, p. 6) added that experiencing qualities is not a sufficient condition for knowledge, but it is necessary. With regard to the second point, it could be claimed that the next point provides a view of the embodiment and extended phenomenological–cognitive system (Thompson & Stapleton, 2009; Telkänranta, 2015 and Silberstein & Chemero 2012) of quality. Dewey embeds qualities in the context, that is, he sees qualities as belonging to a situation. Being in the situation distinguishes the qualities according to their functions:

The qualities never were ‘in’ the organism; they always were qualities of interactions in which both extra-organic things and organism partake. [...] They are as much qualities of the things engaged as of the organism. For purposes of control they may be referred specifically to either the thing or to the organism or to a specified structure of the organism. (Experience and Nature, p. 259 cited in Bernstein, 1961, p. 7)

Therefore, qualities can be seen as mental or physical or both, depending on the occasion. The third point emphasises that through feeling, we do not define or identify qualities; instead, immediate qualities are in a relation with feeling when it is an experience. The quality of experience pertains to transaction between an organism and the environment. The three points clarify that the moment of recognizing an immediate quality is at the threshold of Secondness and Thirdness. For this reason, an immediate quality seems numinous and difficult to describe. In Dewey’s model of reflection thought and action, it is the momentum from dis-

turbance to intellectualization and definition of the problem, which clearly involves reflection (see Figure 1.).

Bernstein (1961) criticised Dewey in this respect. He pointed out Dewey's ambiguous usage of terminology and the meaning of immediacy and quality as experienced or as intrinsically possessed by all natural existence. Bernstein concluded that such ambiguity originated in the different approaches that Dewey used in attempting to resolve the opposition between idealism and realism. He added that Dewey failed to reconcile this opposition. The result is an unholy alliance (Bernstein, 1961, p. 14). Although Bernstein's claim is important, it is beyond the scope of the present article. I have taken the view that Alhanen (2013, p. 14) provides in his book on Dewey's philosophy of experience, namely that the nature of experience is "ecological", which means that people or any living organism are to be understood through their interdependent relationship with their environment. The importance lies in acknowledging that qualitative immediacy belongs to experiencing a specific time and place, that is, a particular experience. It could be said that qualitative immediacy is doubt prone because becoming aware of the immediate quality pushes the conscious to change the situation, habits and/or understanding. This resistance to act as one has been used to acting brings about hesitation, delay and wavering (Dewey, LW, 8, p. 201). The reflective thought appears to aim to *define the problem*, that is, what is wrong in the situation (stage 2 in Figure 1.). The problem directs awareness and future reflection for acquiring new practices (habits) (Dewey LW 12, p. 112).

Weak Form of Inference

The process of reflection and making meaning starts with Secondness in the form of resistance (i.e., brute force). The habit falls short, that is, it does not work. It is also the interaction based on awareness directed toward the environment that supports the reflection. Silberstein and Chemero (2012, p. 35) described this "system" as a heterogeneous composition of brain, body, and niche, which are non-linearly coupled to one another. It is a system that is relational and dynamic, and interactions take place among the heterogeneous parts on multiple spatial and temporal scales. The spatial and temporal scales underline the situation of the process and the continuous interaction with all non-linearly linked parts. The interaction is Secondness: when the interaction does not work, the pause caused by doubt emerges (Firstness). Making sense of the situation occurs as reflection in the form of abduction (Thirdness in the stages of 2 and 3 in Figure 1) (see Paavola 2004, 2004a, 2006). Abduction provides the first pinpoint and definition of the problem, leading to preliminary questions such as "why". In the form of abduction, the interrogative model of inquiry (I-model) and the model of trialogical learning are similar. These models are worth discussing in relation to Dewey's model on reflection and action. Paavola, Hakkarainen and Sintonen (2006) described the relations between the I-model, trialogical learning and distributed cognition. The similarities are summarised in the following manner based on Paavola et al. (2006):

- Abductive inference is closely connected to the questioning in the interrogative model. The basic pattern is a kind of a dialogue where Nature provides hints and clues, and the inquirer tries to find new hypotheses to explain the phenomena.

- Abduction is triggered when a "surprising or otherwise perplexing state of things" occurs (Peirce, CP 8.229) or by "an extraordinary combination of characters" (Peirce, EP 2:898-899; see also CP 5.189).

– Abductive models are intended to develop a conceptual means for analysing the dynamics of inquiry by focusing on the first phases: namely, the forming of new ideas (Paavola, 2004).

According to Paavola and Hakkarainen (2005) and Arrighi and Ferrario (2008), abductive inference is a “weak” form of inference. It selects and uses clue-like signs to proceed toward tentative hypotheses. These hypotheses are tested in subsequent inquiries. To be able to direct attention, recognising the clue-like sign requires a tight interaction with the environment. This relation with environment, signs and humans is found in trialogical learning. The weak form of inference uses distributed cognition according to three perspectives: 1) physically distributed (use of external objects, affordances, artefacts and tools to support intelligent activity); 2) socially distributed cognition (social interaction, collaboration and social practices enhancing the activity); 3) temporally distributed cognition (use of representations, tools, methods, etc.). However, the aspects of distributed cognition can be extended to involve embodied aspects, which were discussed by Magnani (2004). For Magnani (2004), manipulative abduction brings forward “information” about the senses and implicit meanings that derive from the body proper (i.e., tacit knowledge). The model of manipulative abduction emphasises thinking “through doing”, in which external representations (mediators/signs) are sensed and experienced by the body (see Magnani, 2004, p. 229, 233–242; Magnani, 2001). Manipulative abduction is a specific kind of cognitive manipulation in which the organism (agent) that uses embodied knowledge begins to structure the clues (affordances) perceived, some of which the organism is not consciously aware, into meaningful structures or signs. In the four levels of cognition described by Telkänranta (2015), manipulative abduction occurs in the two first levels—emotional awareness and cognitive awareness. Abduction, from the point of view of embodied and distributed cognition, indicates that experience is at the core of potential reflection. The socially distributed aspect emerges through the ability to share experiences and construct knowledge in collaboration, for which a common ground is required. Peirce indicated the same requirement by using concepts such as common ground, common experience and collateral observation:

The universe must be well known and mutually known to be known and agreed to exist, in some sense, between speaker and hearer, between the mind as appealing to its own further consideration and the mind as so appealed to, or there can be no communication, or ‘common ground,’ at all. (Peirce, CP 3.621; see also Peirce, CP 8.179)

Paavola and Hakkarainen, (2005a) emphasised the role of the object or artefacts in interaction, wherein common and mediating objects of activity within a common ground provide the basis for interaction. The interpretation of signs occurs through social processes (Bergman, 2004, pp. 40–80). In similar experiences, social processes and the relationship to the shared “world” are intertwined. Paavola et al. (2006) described the role of indices in the process of sharing experience as based on a common ground. The use of indices help to point toward the shared artefacts, experiences, and processes that are necessary to reach a common understanding (see Peirce, CP 3.621; CP 5.212; CP 6.490; Bergman, 2004, pp. 370–386). Hence, it can be said that signs augment human intelligence. Peirce’s semiotics and the augmentation view of signs provide the means to understand abduction as a part of distributed and embodied cognition.

In Dewey’s model (Figure 1), trialogical learning, distributed cognition, augmentationism and the extended phenomenological–cognitive system are insinuated in the first three

stages in the cycle of reflective thought and action. From the perspective on which this article is based, these three starting stages are the most important in considering experience, awareness and reflection. These three stages incorporate a flow from Secondness to Firstness to potential Thirdness and back to Secondness. This flow includes reflection when Thirdness comes into play. The description of the model often begins with doubt when the action and resistance are gone, and the feeling of disturbance is present. However, when it commences in routinised habit, doubt emerges because things do not seem right. In both, the feeling of a moment in which the environment seems clear is the moment in which awareness and attention are heightened. The distinct meanings that Dewey provides for the concept of experience can be seen to occur within the three first stages because routinised experience is broken and the “weak form of inference” steps in the form of an intellectual reflective experience:

The term experience may thus be interpreted with reference either to the empirical or to the experimental attitude of mind. Experience is not a rigid and closed thing; it is vital, and hence growing. When dominated by the past, by custom and routine, it is often opposed to the reasonable, the thoughtful. But experience also includes the reflection that sets us free from the limiting influence of sense, appetite, and tradition. (Dewey, LW 8: 277)

The shifts among different kinds of experiences and the formation of a tentative working hypothesis using abductive means occurs in stage (3) (see Figure 1) when the conditions of the situation are studied and a working hypothesis is formulated. In this phase, the analysis and diagnosis of the conditions take place. The conditions include both material and social conditions and the means and resources with which the problem is supposed to be resolved. It is where negotiations and sharing of experiences using indices occur, and the common ground of the participants expands and deepens (Figure 2). Shared understanding is formed, and hypotheses and solutions for research, work life or practices are created. A working hypothesis is a guiding idea or a plan. The working hypothesis, like the problem, is tentative. Figure 2 displays the first three steps of the reflection in-action process from another perspective, namely that of experience, doubt, reflection and shared experiences. The area where the ellipses overlap is the common ground of the participants. In sharing experiences or finding meaning, and understanding the uncertainty (e.g., the reason that a habit does not work), previous similar experiences are sought, and the material artefacts aid in this process. The material artefacts are also used to point to experiences by using indices.

Figure 2. Three first steps of the reflection in-action process.

The last phases of Dewey's model (Figure 1) are less interesting from the point of view of numinous experience. The stages of (4) reasoning—in a narrow sense—and (5) testing the hypothesis by action are well discussed and explained in most of the learning approaches considered in this article: inquiry-based learning, problem-based learning and progressive inquiry (PI-Model). The point I want to make is that in design and learning, the focus should be on the weak form of reasoning in the first three phases in Dewey's cycle of reflective thought and action. Hence, the environment and artefacts are taken into account as essential elements in making meaning and sharing experiences.

Weak Form of Inference as the Basis of Design and Learning

The design of places, spaces and environment (i.e., the context) creates a difference in the learning processes. How people interact in an environment and with each other can support experiencing, sharing experiences and triggering reflections. Experiences are the core of making meaning and learning. Considering the artefacts through which, by which and within which we interact is essential in (re-)designing things, items, tools and spaces. The constraints and potentials of contexts should be investigated to determine whether they could be used or designed as promoters of experience. The spatial arrangement, the salience of selected things in space, and interactions of the space and artefacts are important to consider in designing smart

items (IoT and IoE) in a context. The enhanced contexts can be directed toward self-controlled experiencing, which supports thinking and reflection, such as the three in the first phases of Dewey's cycle of reflective thought and action and Peirce's notion of Thirdness where self-controlled agency in habit change comes into play by using the weak form of inference. View in this manner, experience resembles Schön's (1995) epistemology, which highlighted the potential for research and the practice of reflection in-action. Reflection in-action emphasised the weak form of inference as an artful improvisation that professionals learn and use in practice. In designing for learning, attention should be paid to the following:

- Catching the moment of wavering to support reflection-in-action at its highest level to allow for habit change;
- Enhancing and supporting self-controlled agency by helping to direct attention to specific clues, indices and affordances for sharing experiences;
- Using context and situatedness in the design to allow for multisensorial and tangible reflections in which the ubiquitous experiential process is not seen as stable but as stretching to include the past and future.

This framework will affect the design. Current design is drifting away from the natural interaction within the environment, and the respect for experience is future directed, ubiquitous, multisensorial and self-controlled, thus changing the ways in which design is approached and practised. However, the methods may remain the same. The benefits will include being able to address the right kind of issues in design and learning, especially when taking into account the potential that IoT (IoE) provide for the relational and dynamical interactions among heterogeneous parts. Designing tools for learning can then enhance holistic human reflection-in-action and support attempts to reflect. Hence, design should consider the doubting moment that emerges in actions, work or practices and supporting reflection and sharing of experiences.

The current era provides the potential for enhancing the environment not only because of the new understanding of cognition and consciousness but also because of technological development that allows increasingly ubiquitous possibilities for design (see e.g., Bauters, Purma, & Leinonen, 2014). It should not be design a particular experience, or designing for particular kind of emotions and feelings, but for different manners to notice, become aware, use, and support the moment of hesitation from which reflection, habit change and learning grows. Hence, according to Dewey, "the central problem of an education based upon experience is to select the kind of present experiences that live on fruitfully in and creatively in subsequent experiences" (Dewey, 1938/1997, p. 27).

Abbreviations used in text

- EW: Dewey, J. (1969-1972). *The Early Works*, 5 Vols. Carbondale: Southern Illinois University Press,
 MW: Dewey, J. (1976-1988). *The Middle Works*, 15 Vols. Carbondale: Southern Illinois University Press.
 LW: Dewey, J. (1981-1991). *The Late Works*, 17 Vols. Carbondale: Southern Illinois University Press.
 AE: Art as Experience, LW 10
 DE: Democracy and Education, MW 9
 LTI: Logic: The Theory of Inquiry, LW 12
 EN: Experience and Nature LW 1
 RP Reconstruction in Philosophy, MW 12

PP: The Public and Its Problems, LW 12

E: Ethics, revised edition, LW 13

HNC: Human Nature and Conduct, MW 14

Notes

¹ I am aware that many others (e.g., Sanders & Stappers, 2008; Garrett, 2011; Prahalad & Ramaswamy 2004) should have been cited in the discourse, but I could not include them because of the limited space allotted to this article.

² I was asked whether it is relevant to comment on Kolb's approach because the challenges are known. However, my review of the literature and participation in discussions at conferences confirmed that many have not questioned Kolb's theoretical claims. A simple search in, for instance, Science Direct resulted in around 400 papers that do not refer to Kolb's work critically.

³ A conference on the topic of design education Retrieved from <http://interaction16.ixda.org/interaction-design-education-summit/>

References

- Alhanen, K. (2013). *John Deweyn kokemusfilosofia*. [John Dewey's experience philosophy] Helsinki: Gaudeamus.
- Arrighi, C., & Ferrario, R. (2008). Abductive reasoning, interpretation and collaborative processes. *Foundations of Science*, 13(1), 75-87.
- Baltes, P. B., & Staudinger, U. M. (2000). Wisdom: A metaheuristic (pragmatic) to orchestrate mind and virtue toward excellence. *American Psychologist*, 55(1), 122-136. doi:10.1037/0003-066X.55.1.122
- Bauters, M., Purma, J., & Leinonen, T. (2014). In-time on-place learning. In *10th international conference on mobile learning 2014. International Association for Development of the Information Society IADIS Press*, p. Er.
- Beck, S. (2015). The problem of expertise: From experience to skilful practices to expertise. Ecological and pragmatist perspectives. *European Journal of Pragmatism and American Philosophy*, 7(1), 8-23.
- Beckman, S. L., & Barry, M. (2007). Innovation as a learning process: Embedding design thinking. *California Management Review*, 50(1), 25-56.
- Bereiter, C., & Scardamalia, M. (1993). *Surpassing ourselves. An inquiry into the nature and implications of expertise*. Chicago: Open Court.
- Bergman, M. (2004). Fields of signification: Explorations in Charles S. Peirce's theory of signs. *Philosophical Studies from the University of Helsinki*, 6.
- Bergman, M. (2005). C. S. Peirce's dialogical conception of sign processes. *Studies in Philosophy and Education*, 24(3-4), 213-233. doi:10.1007/s11217-005-3845-0.
- Bergman, M. (2013). Fields of rhetoric: Inquiry, communication, and learning. *Special Issue: Peirce's New Rhetoric: Prospects for educational theory and research in Educational Philosophy and Theory: Incorporating*, 45(7), 737-754. doi:10.1111/j.1469-5812.2010.00738.x.
- Bernstein, R. J. (1961). John Dewey's metaphysics of experience. *The Journal of Philosophy*, 58(1), 5-14. doi:10.2307/2023564.
- Bødker, S. (1996). Creating conditions for participation: Conflicts and resources in systems development. *Human-Computer Interaction*, 11(3), 215-236. doi:10.1207/s15327051hci1103_2.
- Clark, A. (2003). *Natural-born cyborgs: Minds, technologies, and the future of human intelligence*. New York: Oxford University Press.
- Damasio, A. R. (2001). Emotion and the human brain. *Annals of the New York Academy of Sciences*, 935(1), 101-106. doi:10.1111/j.1749-6632.2001.tb03475.x.

- Dewey, J. (1938/1997). *Experience and education*. New York, NY: Simon and Schuster.
- Dewey, J. (1946). Peirce's theory of linguistic signs, thought, and meaning. *The Journal of Philosophy*, 43(4), 85–95. doi:10.2307/2019493.
- Dewey, J. (1969-1972). The Early Works, 5 Vols. Carbondale: Southern Illinois University Press.
- Dewey, J. (1976-1988). The Middle Works, 15 Vols. Carbondale: Southern Illinois University Press.
- Dewey, J. (1981-1991). The Late Works, 17 Vols. Carbondale: Southern Illinois University Press.
- Dourish, P. (2001). *Where the action is: The foundations of embodied interaction*. Cambridge, MA: MIT Press.
- Ehn, P. (1988). *Work-oriented design of computer artifacts*. Stockholm: Arbetslivscentrum.
- Ehn, P. (1993). Scandinavian design: On participation and skill. In D. Schuler & A. Namioka (Eds.), *Participatory design: Principles and practices* (pp. 41-77). Hillsdale, NJ: Lawrence Erlbaum.
- Eraut, M. (2000). Non-formal learning and tacit knowledge in professional work. *British Journal of Educational Psychology*, 70, 113–136. doi:10.1348/000709900158001.
- Eraut, M. (2004). Informal learning in the workplace. *Studies in Continuing Education*, 26(2), 247–273. doi:10.1080/158037042000225245.
- FitzGerald, E. (2012). Creating user-generated content for geolocated learning: An authoring framework. *Journal of Computer Assisted Learning*, 28(3), 195–207. doi:10.1111/j.1365-2729.2012.00481.x.
- Forlizzi, J., & Battarbee, K. (2004). Understanding experience in interactive systems. *Proceedings of the 5th conference on designing interactive systems: Processes, practices, methods, and techniques (DIS '04)* (pp. 261–268). New York: ACM. doi:10.1145/1013115.1013152.
- Garrett, J. J. (2011). *Elements of user experience: User-centered design for the web and beyond*. Berkeley, Calif.: New Riders cop.
- Greenbaum J., & Kyng, M. (1991). *Design at work: Cooperative design of computer systems*. Hillsdale (NJ): Lawrence Erlbaum.
- Gregory, J. (2003). Scandinavian approaches to participatory design. *International Journal of Engineering Education*, 19(1), 62-74.
- Hassenzahl, M. (2010). Experience design: Technology for all the right reasons. *Synthesis Lectures on Human-Centered Informatics*, 3(1), 1-95. doi:10.2200/S00261ED1V01Y201003HCI008.
- Hintikka, J. (1999). *Inquiry as inquiry: A logic of scientific discovery*, Jaakko Hintikka. *Selected Papers*, Volume 5, Kluwer Academic Publishers, Dordrecht.
- Hoffmeyer, Jesper. 2008. The semiotic niche. *Journal of Mediterranean Ecology* 9 5-30.
- Innis, R. E. (2004). The tacit logic of ritual embodiments. *Social Analysis*, 48(2), 197-212. doi:10.3167/015597704782352573
- Interaction Design Education Summit Conference. (2016). In 1st to 4th of March 2016 Helsinki, Finland. Organized by 2015–2016 Interaction Design Association. Retrieved March 3, 2016 from <http://interaction16.ixda.org/interaction-design-education-summit/>.
- Kaptelinin, V., & Nardi, B. (2012). Activity theory in HCI: Fundamentals and reflections. *Synthesis Lectures Human-Centered Informatics*, 5(1), 1–105. doi:10.2200/S00413ED1V01Y201203HCI013.
- Kilpinen, E. (2000). *The enormous fly-wheel of society: Pragmatism's habitual conception of action and social theory*. Helsinki: University of Helsinki.
- Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice-Hall.
- Magnani, L. (2001). Abduction, reason, and science: Processes of discovery and explanation. New York: Kluwer Academic/Plenum Publishers.
- Magnani, L. (2004). Model-based and manipulative abduction in science. *Foundations of Science*, 9(3), 219-247. doi:10.1023/B:FODA.0000042841.18507.22.
- Miettinen, R. (2000). The concept of experiential learning and John Dewey's theory of reflective thought and action. *International Journal of Lifelong Education*, 19(1), 54-72. doi:10.1080/026013700293458.
- Nardi, B. A. (1996). *Context and consciousness: Activity theory and human-computer interaction*. Cambridge, MA: MIT Press.
- Norman, D. A. (2004). *Emotion design: Why we love (or hate) everyday things*. New York: Basic books.

- Olteanu, A. (2017). Reading history: Education, semiotics, and edusemiotics. In I. Semetsky (Ed.), *Edusemiotics: A handbook* (pp. 193–205). Singapore: Springer. doi:10.1007/978-981-10-1495-6_14.
- Oppermann, R., & Specht, M. (2006). Situated learning in the process of work. In D. Hung & M. S. Khine (Eds.), *Engaged learning with emerging technologies* (pp. 69–89). Berlin: Springer-Verlag. doi:10.1007/1-4020-3669-8_4.
- Paavola, S. (2004). Abduction as a logic and methodology of discovery: The importance of strategies. *Foundations of Science*, 9(3), 267–283. doi:10.1023/B:FODA.0000042843.48932.25.
- Paavola, S. (2004a). Abduction through grammar, critic, and methodeutic. *Transactions of the Charles S. Peirce Society*, 40(2), 245–270.
- Paavola, S. (2006). Hansonian and Harmanian abduction as models of discovery. *International Studies in the Philosophy of Science*, 20(01), 93–108. doi:10.1080/02698590600641065.
- Paavola S., & Hakkarainen, K. (2005). The knowledge creation metaphor: An emergent epistemological approach to learning. *Science & Education*, 14(6), 535–557. doi:10.1007/s11191-004-5157-0.
- Paavola, S., & Hakkarainen, K. (2005a). Three abductive solutions to the Meno paradox—with instinct, inference, and distributed cognition. *Studies in Philosophy and Education*, 24(3-4), 235–253. doi:10.1007/s11217-005-3846-z.
- Paavola, S., Hakkarainen, K., & Sintonen, M. (2006). Abduction with dialogical and trialogical means. *Logic Journal of IGPL*, 14(2), 137–150. doi:10.1093/jigpal/jzk010.
- Peirce, C. P. (1931–1935). *Collected papers of Charles Sanders Peirce, Vols. 1–6*. C. Hartshorne & P. Weiss (Eds.). Cambridge, Mass.: Harvard University Press. [Reference to Peirce’s papers will be designated CP followed by volume and paragraph number.].
- Peirce, C. P. (1958). *Collected papers of Charles Sanders Peirce, Vols. 7–8*. A. Burks. (Ed.). Cambridge, Mass.: Harvard University Press. [Reference to Peirce’s papers will be designated CP followed by volume and paragraph number.].
- Peirce, C. P. (1998.) C. S. *The essential Peirce: Selected philosophical writings. 1893–1913, Vol. 2*. Indiana University Press. [Reference to vol. 2 of Essential Peirce will be designated EP 2.].
- Pihlström, S. (2004). Peirce’s place in the pragmatist tradition. In C. Misak (Ed), *The Cambridge companion to Peirce* (pp. 27–57). Cambridge University Press.
- Popper, K. R. (1981). The myth of inductive hypothesis generation. In R. D. Tweney, M. E. Doherty, & C. R. Mynatt (Eds.), *On scientific thinking* (pp. 72–76). New York: Columbia University Press.
- Prahalad, C. K., & Ramaswamy, V. (2004). Co-creation experiences: The next practice in value creation. *Journal of Interactive Marketing*, 18(3), 5–14. doi:10.1002/dir.20015.
- Sanders, E., & Stappers, P. (2008). Co-creation and the new landscapes of design. *CoDesign*, 4(1), 5–18. doi:10.1080/15710880701875068.
- Schön, D. A. (1995). *The reflective practitioner: How professionals think in action*. Aldershot: Arena.
- Shapiro, L. (2014). *The Routledge handbook of embodied cognition*. New York: Routledge, Taylor & Francis Books.
- Shook, J. R. (2000). *Dewey’s empirical theory of knowledge and reality*. Nashville: Vanderbilt University Press.
- Silberstein, M., & Chemero, A. (2012). Complexity and extended phenomenological cognitive systems. *Topics in Cognitive Science*, 4(1), 35–50. doi:10.1111/j.1756-8765.2011.01168.x.
- Spinuzzi, C. (2005). The methodology of participatory design. *Technical Communication*, 52(2), 163–174.
- Stables, A. (2008). Semiosis, Dewey, difference: Implications for pragmatic philosophy of education. *Contemporary Pragmatism*, 5(1), 147–162. doi:10.1163/18758185-90000085.
- Suchman, L. A. (1987). *Plans and situated actions: The problem of human-machine communication*. Cambridge: Cambridge University Press.
- Telkänranta, H. (2015). *Millaista on olla eläin?* [What it is to be an animal?] Suomalaisen Kirjallisuuden Seura.
- Thompson, E., & Stapleton, M. (2009). Making sense of sense-making: Reflections on enactive and extended mind theories. *Topoi*, 28(1), 23–30. doi:10.1007/s11245-008-9043-2.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, Mass.: Harvard University Press.

- Welsh, E. T., Wanberg, C. R., Brown, E. G., & Simmering, M. J. (2003). E-learning: emerging uses, empirical results and future directions. *International Journal of Training and Development*, 7, 245–258. doi:10.1046/j.1360-3736.2003.00184.x.
- Winograd, T., & Flores, F. (1988). *Understanding computers and cognition: A new foundation for design*. Reading, MA: Addison-Wesley.
- Wright, P., & McCarthy, J. (2010). Experience-centered design: designers, users, and communities in dialogue. *Synthesis Lectures on Human-Centered Informatics*, 3(1), 1–123. doi:10.2200/S00229ED1V01Y201003HCI009.