Perspectives on Innovative Designs and Learning

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Abstract. Digitalization has changed ways of learning as well as challenged conditions for creativity in different landscapes of learning. This raises questions about how to approach learning and design in new ways. To address these queries, this conceptual symposium paper presents three perspectives on how innovative designs and learning in analogue and digital activities can promote new metaphors, theories, and methodologies to study these kinds of processes. The first perspective adds a focus on the environment and spaces based on ecological understanding of design and learning with a pivot point on boundaries and people's wayfinding. The second perspective adds a focus on activities with artifacts and people's engagement in creative and playful processes of making and breaking as part of a design and learning process. The third perspective takes the position of collaborative design in educational settings, with a focus on context and sequences, framing and fixing points, and on the choice of material and semiotic resources to express/represent knowledge. Despite differences in these perspectives, they can be used in different educational practices to understand people's engagement in design and learning. The paper shows that differences in perspectives not necessarily represent division or disagreement, but rather exploratory routes that can generate new learning, understanding and resources to approach societal and educational challenges.

Keywords: Innovative designs · Learning · Knowledge representations · Learning ecology · Wayfinding · Play · Exploration · Material interaction

1 Introduction

Digitalization changes people's everyday life, not the least what concerns information seeking, patterns of communication and ways of learning. This change therefore affects and challenges education (and traditional instructional learning) as well as the conditions for creative development in different areas. Given these challenges and the growing complexity of learning and design, there is increased interest from both researchers and practitioners in finding new ways of understanding and fostering people's engagement in learning and design activities. Accordingly, our purpose is to address this issue by

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suggesting three distinct but overlapping perspective of applying and understanding innovative designs and designs for learning, with a focus on (1) conditional framings for learning and design; (2) design as play; and (3) designs for learning. To assemble these three perspectives, we begin with introducing essential conceptualizations of each of them, including an identification of their commonalities. We next elaborate on the three perspectives and propositions illustrating aspects that are likely to elucidate innovative learning and design processes. It is our hope that these clarifications eventually can contribute to identifying opportunities for future work within these three lines of understanding people's engagement in learning and design. A conclusive discussion ends the paper by synthesizing the three perspectives and their propositions of studying, approaching, or acting on contemporary challenges in a continuously changing world.

Importantly, we do not intend to be exhaustive with our explorations, rather the constructs we chose are intended to exemplify possibilities for researchers and practitioners in the field of designs for learning. Implicitly, this is intended to highlight directions for future inquiry.

2 Towards a Turn in Educational Thinking

The above-mentioned changes put a new, overall interest on lifelong learning – in terms of creativity, reflection, collaboration, problem solving, adaptability and communication [1]. In the educational sector, this has been discussed by OECD in term of 21st Century Skills (or Competences) to prepare the younger generations to handle messy problems, uncertainty, and divergent interests. Interesting enough, this also calls for a new interest in Bildung (and *fronesis*), not only in new skills. Play *and* learning are no longer opposites, rather aspects of engagement [2–6]. These are examples of propositions that are issued in the contemporary debate on digitalization, learning and design in educational and design-oriented research and practices. The three perspectives proposed in the present paper put forth such propositions and statement by introducing learning ecologies to understand and analyze complex learning processes. Furthermore, to discuss how creativity and play can act as tools to support practitioner as well as researchers in designing for and researching play experiences. Finally, to elaborate on designs for learning as material and semiotic resources that can be used during the study and performance of different learning sequences. Thus, all three perspectives address the processes of learning and design from an epistemological, to a practical and analytic viewpoint.

2.1 Innovative Designs and Learning

The first perspective describes on a general level the epistemological framing of design and learning across shifting boundaries, characterized by *wayfinding across evolving contextual settings*, blurred boundaries, and ecotones (where people and environment are interrelated). In this section, a learning ecology approach is applied to understand the complexities of design and learning processes related to spaces and places. It is stressed that the understanding of the complexity of learning and design processes are afforded by wayfinding, and people's individual and collective knowledge creation within continuous

evolving learning environments. Thus, the frame of an ecological understanding is argued to capture the complexity in design and learning processes at an epistemological level.

The second perspective describes *design as play*. It takes another approach to innovative learning and design framed around the actions of people as designers. This part addresses how design, learning and play are connected processes creating powerful learning opportunities across different areas of development. It is stressed that a design process involves explorative actions and hands-on activities with artefacts. It is also stressed that this is a social process, where not only materiality talks back to the designers but also other people participating in the design process. The idea of *making and breaking* seem to be an essential part in the design process allowing the participant to create, re-design and gain new knowledge through iterative cycles of inquiry.

Finally, the third perspective focus on *designs for learning* and knowledge representations, performative and collaborative learning settings, and virtual cases.

All the three presented perspectives on design and learning offer a way to apply and understand people's engagement in learning and design. Despite the differences between these approaches, they share a mutual understanding of design and learning, which goes beyond the idea of fixed processes and certain steps. Design and learning are seen as situated and complex activities, where people, spaces, places and artefacts are influenced by and affect each other.

3 Epistemological Framing of Design and Learning Across Shifting Boundaries

Emerging technologies and people's use of these technologies are continually under development. These technologies are created to afford people's needs and to meet existing challenges. Many emerging technologies seem to be crossing borders between different professions, e.g., from the leisure industry to educational settings. For instance, games and game principles are developed and redesigned to game-based learning design and virtual reality is changed to accommodate educational purposes. The border crossing of people's use of technologies calls for theoretical perspectives on design, learning and innovation inspired by ecological thinking. Ecological thinking offers a frame for understanding the complexity of design in learning and a frame for design for learning, as it provides an understanding of knowledge creation in a complex and interconnected world where emerging technologies, networks and knowledge modes are under continuous change and development. Learning ecology perspectives contribute to a conceptual frame embracing existing challenges of navigating a technology-rich and continuously developing society. Working from a learning ecology perspective contributes to a language for people's interactions and activities across different environments. The ecological approach accommodates circumstances under which people can gain lifelong learning skills [7]. For instance, Siemens [8:54] stresses that a learning ecology frames the space in which learning occurs in a way where knowledge is shared, co-created, and recreated and in a mode where experimentation and failure are recognized as a part of a learning process. Thus, a learning ecology approach offers a dynamic perspective on learning as ubiquitous, dynamic, and flexible.

3.1 Between Boundaries

Moreover, a learning ecology approach gives researchers an epistemological frame for investigating people's interaction across settings and agencies [7]. From a learning ecology perspective, it is also recognized that boundaries are permeable, blurred, and multiple and that the environment and people mutually influence each other [9]. The concepts of ecotones and ecoclines are in this paper suggested for the conceptualizing of these permeable and blurred boundaries. Ecotones and ecoclines are border zones where there is a rich diversity and emerging of new "species". In these spaces between borders, the concept of species can be understood broadly and metaphorically as both technologies, learning design, people, and other entities. The people's border crossing design and learning processes are here framed by the metaphor of "wayfinding".

Ecotones and ecoclines are concepts derived from biology. Ecotones are characterized as the zones where two ecosystems meet and are in tension. These zones might have vastly different forms. For instance, such zones can be blurry, sharp, or even mixed in different ways [10]. Ecotones are generally defined as ecological transition zones with gradients and diverse vegetation between two relatively but homogeneous ecological communities. However, van der Maarel [11] has stressed a need to distinguish between ecotones and ecoclines. According to van der Maarel [11], the difference is that ecotones represent a stressful zone of coincidence contrary to ecoclines which are characterized to be more stable but still heterogeneous.

3.2 Humans' Wayfinding in Learning and Design

Wayfinding is a concept that has been used in social anthropology, psychology, and geography [12–14]. Golledge [13] represents the psychological understanding and describes it as people's travel or search for different purposes, where environmental knowledge is acquired. Simonsen connects wayfinding to practice, spatiality and embodiment in her approach based on social analysis/human geography: "Active bodies, using their acquired schemes and habits, position their world around themselves and constitute that world as "ready-to-hand", to use Heidegger's [15:107] expression. These are moving bodies "measuring" space in their active construction of a meaningful world. In taking up or inhabiting space, bodies move through it and are affected by the "where" of that movement. It is through this movement that space as well as bodies take shape. Inhabiting space is about "finding our way" and how we come to "feel at home". It, therefore, involves a continuous negotiation between what is familiar and unfamiliar, making space habitable but also receiving new impression" [15:153].

Ingold [12] is working within the field of social anthropology, and he describes wayfinding as the process where: "…people 'feel their way through a world that is itself in motion, continually coming into being through the combined action of human and non-human agencies" [12:155]. The difference between Ingold and Simonsen's understanding of wayfinding is that Ingold acknowledges that wayfinding is a matter of people traversing a fixed environment and the interaction between the human and the environment, e.g., as when peoples are placing their footprint in nature. Ingold´s understanding of wayfinding has been found to accommodate contemporary understandings of learning as wayfinding [16, 17] and learning ecology designs [7]. Learning as wayfinding is here

argued to be a metaphor capturing human's knowledge- and identity development here understood as learning. It is not a pre-fixed goal-oriented approach to learning. Instead, it is a process of mapping the learning landscape and finding paths in movements, either physical or mental. It is also a process of interconnections between people and other entities crossing borders and finding their way through new knowledge, understanding and development of oneself or new ideas and knowledge in the ecotones. Sometimes this process might be stressful and flourish in these kinds of ecotones, as in the case in accommodative cognitive processes and when learners are traversing previously gained knowledge. Sometimes the process might be more smoothly but still adding new knowledge, just as in ecoclines and assimilative cognitive processes. An example of how the landscape forms people's journeys is, when people are hiking in the Norwegian mountains, they search for and try to follow the paths of previous peoples walking and might be lost and have to find their way, but sometimes they are supported in their pathfinding by the cains placed by ancestors. This example can be transferred to educational settings, e.g., when students try to find their way and gain new knowledge through experimentation supported by previous learning experiences and knowledge. However, people are often not alone in their learning journey and besides the learning environment supporting their knowledge development, peers, teachers, and artefacts such as books, technologies, and smartphones at hand scaffold learners' journey.

Thus, an ecological approach to learning as wayfinding seems to offer a frame for understanding the process of design in learning and development, as the movement in design processes. These are characterized by abductive processes of research, ideation, sketching and generating design patterns embedded within a particular environmental zone, is stressed to be a process of wayfinding, and thus mapping and mapmaking just as Ingold [12] described it. In this sense, it is argued that the ecological metaphor of learning as wayfinding can deepen our understanding of the learning process and the learners involved [17], particularly with respect to understanding learners as knowledge landscape designers and way finders embedded in contextual settings navigating, mapping and mapmaking ecotones and ecoclines.

The connection between wayfinding and design as learning lies in the process and the interconnections between entities, e.g. people, artefacts, and spaces (mental, physical, and digital). In this way, the creative exploration in wayfinding can be equated with a design process in modern learning activities within the ontological framework of ecological thinking. By extending the understanding of design processes to a frame of ecological understanding of learning as wayfinding, the complexity of learning and design processes are captured, acknowledging the learning trajectories of people's individual and collective mapmaking and thus their knowledge creation across continuously evolving spaces, places, and ecotones.

4 Designing as Play

This section explores another perspective on innovative designs and learning by focusing on design and play situations and processes where educators and children are, or attempt to be, explorative and sensitive to material and immaterial resources when designing and playing together. Design and play can be seen as being at odds with each other, yet

they share similarities. On the one hand, both promote curiosity and exploration, which supports interest and acquisition of knowledge. On the other hand, design typically leads to solutions of problems, whereas play is considered as an open-ended asset encouraging imagination. Similarly, designers curiously ask the question "how" in order to get to a desired solution, while playing humans imaginarily ask the question "what if". Still, both questions reflect a wonder about the creation of a possible future.

From a design perspective, Stappers [18] refers to an act of designing as the locus where new ideas become alive when they are confronted with the world. Such confrontations lead to an instantiation of a designed idea in the form of *prototypes*. Zimmerman et al. [19:493] state that this is a way for designers to create "a product that transforms the world from its current state to a preferred state". Sutton-Smith [20], a recognized play researcher, emphasizes the variability of play, where he acknowledges its quirkiness, redundancy, and flexibility. He states that play is not any trivial activity, but a powerful human asset for explorative interactions between people and the environment. This puts forward the concept of play as a somewhat disruptive activity that can foster novel idea generation by processes of *making and breaking* novel and traditional ways of interacting with the world.

In relation to the focus of the present paper, we argue that it is in this contradictory as well as overlapping crossroad between design and play where innovative designs and learning situations can emerge. In addition, we emphasize that such making and breaking processes are pivotal to nurture innovative design and learning. This by reinforcing and enabling us to ask questions of *how* and *what if* to support actions of connecting, decoupling and re-connecting ideas and hypotheses, i.e. making and breaking in prototyping-like activities. As such, both material and immaterial interactions are highlighted. Next, we will unfold designing as playing in terms of exploration through a material lens.

4.1 Exploration Through Making and Breaking

Explorative actions can be sparked by imagination and hands-on doings. In his book, Linnell [21] illustrates how people involved in explorative activities orient themselves in material, sensational and symbolic ways. In this way, the author describes the matter of exploration as a complex and often unexpected chain of expressions. In the design domain. Such expressive processes might be described as emergent, while in the field of play they could be described as social forms of imagination. Vygotsky [22:11] stated that "A child's play is not simply a reproduction of what he has experienced, but a creative reworking of the impressions he has acquired." Understanding exploration in this way means that what a child does is combining prior experiences to create a new concrete situation. This is the essence of imagination. Thus, the significance of exploration has to do with being motivated to follow one's interest and imaginary experimentation with ideas. By opening space for design as play processes, designers and educators must constantly explore the interests, ideas, and motives of children. This would imply that perspectives of children themselves come into play [23], which would have important implications for adult-child relationships. This, in turn, would nurture innovative designs and learning. Design has taken the form of co-design [24]. In the Nordic countries there is

a tradition of working with design in close collaboration with stakeholders; participatory design [25].

Participatory design and co-creation are fruitful ways to foster exploration, in particular when mediated by digital and analogue tools connecting exploration closely to acts of making and breaking [26–28]. These kinds of acts correspond to both design and play by proceeding through iterative and imaginative cycles considering the wonder of *what could be* as well as perceived fuzziness [19, 29, 30]. Our previous studies including a combination of analogue (foam clay, LEGO, paper, cardboard boxes, foam bricks) and digital (robotics, Mindstorms, VR and digital games) resources in children's early years' education [26, 27, 31, 32] have shown that this combination promote children to explore boundaries, negotiated strategies to sustain their imaginative exploration. They were increasingly inspired by testing their ideas by making them in, for example clay, LEGO or Mindstorms and then, breaking them apart and trying new things. Thus, we argue that material interactions and *what if* spaces for children to become inspired and experience both contradictions and desired outcomes.

4.2 Material Interaction Through Prototyping

Material properties can help in envisioning innovative designs as well as learning about boundaries of the material itself. *Texture*, on the other hand, can communicate material properties through its material appearance. Attention to *details* can add value to material interaction in terms of their aesthetic quality and offer insights into how they can be used to give form to a design. Focusing on *wholeness* has to do with an overall composition [33]. Considering Wiberg's [33] approach, we claim that prototyping becomes a central anchor when it comes to bringing material interaction to life. Furthermore, acts of prototyping frame ideas and imaginary wonders that are in play, which also force people to discuss, critique and reflect. Prototyping as an activity constitutes an unfinished work and hence open for experimentation and sensing of future situations [34]. In this way, material interaction becomes more than a conversation with the material and more than a representation of concepts or ideas. As such, it extends Schön's [35] statement that materials talk back to designers. We would argue that material interaction through prototyping brings inspiration and sensation, which in turn have an important impact on innovation, design, and learning.

To exemplify, when children in our studies should transform a centicube-model of a house to natural size by means of cardboard boxes, the centicube-model and cardboard boxes provided an in-depth understanding about mathematical concepts as well as of the materials' constraints, possibilities, and textures. The children were concerned about how they should communicate the details of the full-size house of cardboard boxes so that their intended centicube design could be properly understood by the others. This clearly spurred, directed, and inspired their prototyping activity.

To sum up, it was not only the environment and the material resources that offered making and breaking as well as prototyping experiences, but also the way in which the facilitators stood back and enabled sufficient space for the children to explore and to break boundaries. Following the children's ideas and interests meant that the facilitators were not only flexible in their support of the children's actions, but also that they themselves explored possibilities to support the children's experiences in the pursuit of continuous

learning. Hence, we emphasize the impact of material (prototyping) and immaterial (imagination) interactions as this, when melded together, contributes to change and diversity. Expressed differently, such interactions have a sustained impact on children's innovative designs and learning.

5 Designs for Learning

The concept of design can be given many different meanings. It is both a verb and a noun, and it can denote a process as well as a product. It could further denote a field of research as well as a theoretic approach or a method that is used for doing research [36]. Design could be understood as a way to construct a prototype for mass production of a specific artefact, but it could also be the very process of investigating a phenomenon anew, and to build up a new theoretic understanding – design (practice) as the prerequisite for theory-building [37].

The traditional idea of design as "giving the thought a form" focused on *form and function*, and on the aesthetics and usability of a product. Contemporary, collaborative and process-oriented perspectives challenge this view, with a focus on *function and meaning* [38].

In designs for learning [39–41], the focus is both on material and semiotic resources, and how these are used during different learning sequences. We cannot "see" learning as such, only the traces of learning and new knowledge in terms of new representation – how the learners are able to show what they have learnt and how they have understood a phenomenon or a field of knowledge [42]. This is also a question of understanding how knowledge can be represented multimodally in different ways, and an understanding of learning as a fundamentally dialogical process (epistemologically as well as ontologically) [43].

To study learning from this point of view is to focus on context and sequences, framing and fixing points, and on the choice of material and semiotic resources to express/represent knowledge. Designs for learning thus also highlight existing "cultures of recognition": i.e. what is "seen as", and "recognized as", learning and knowledge [44]. Representations and representational artefacts can be used to relieve or reinforce cognitive processes, and also to coordinate different information units. This leads us further to the idea of sketching and the construction of new design patterns.

5.1 Sketching

From a design-oriented perspective on learning, as shortly outlined above, learning can only be studied in terms of sign-making and how knowledge has been transformed (or re-designed) into a new representation. Thus, learning can be conceptualized in terms of the (time-based) difference between someone's capability to express things anew, to do new kinds of analysis, to use new techniques or to use established techniques in a new way. A way to study how someone conceptualizes, shows, and finalizes something learnt (or a new idea) is by collecting information from the very process itself, highlighting which elements that have been of most importance, which decisions that have been made,

as well as which expressions that are most sufficient for (relevant) others to understand the new idea (or what was learnt) [41].

In shared and collaborative design work, design representations aid to express thoughts and ideas, and there is something shared and inspectable to critique and collaboratively develop further [45]. Moreover, in communication with stakeholders, to communicate and present ideas of future systems and artefacts, their functionality and future use. Hence, the process of creating design representations as well as the results from it serve many complementary purposes.

5.2 Design Patterns

The concept of design pattern as originally introduced by architect Christopher Alexander, consists of a three-part rule, which expresses a relation between a context, a problem, and a solution [46]. In his work on design patterns, Alexander attempted to document collective knowledge about urban design at different scales ranging from regions and cities, to buildings, rooms and even to the detailed level of doorknobs. The idea of using design patterns to share good examples of solutions to recurring problems has been picked up in several and different fields of research and practice, e.g. within the fields of interaction design, technology enhanced learning and education.

When design patterns have been used within the field of interaction design, design patterns as a resource in the design work have proven to work both as a starting point for design by providing examples, as well as an inspiration for the design of certain products or processes. This could also be expressed in terms of going beyond the individual to integrate social networks and digital tools in a networked society [47] which redirects attention from tools to communities.

5.3 Participatory Pattern Design

Participatory pattern design, as rooted in the Scandinavian school of participatory design, views (in this case) teachers as domain experts on teaching, who are invited into a design process of developing a common resource of solutions to teaching problems. Into this process, teachers bring their design problems or solutions having their origin in their own teaching practice. Work and research within participatory design use a range of techniques, methods and practices including different types of workshops, design games, multimodal narratives, and constructions. By interacting and learning in each other's contexts, a mutual understanding between designers and participants is developed. In addition to this, the patterns could improve design performance as well as educate the designer/teacher. Accordingly, this includes not only practical gains of capturing teaching experience in the format of design patterns, but also of the designing of "learning places" (i.e. learning environments that are wanted by teachers and students and constitute a coherent whole) for both teachers and learners.

6 Conclusive Discussion

In this paper, we have presented three overlapping perspectives on how to approach learning and design in innovative ways, but from different points of view. All perspectives

address the questions of how to investigate, approach or act on the contemporary challenges in a continuously evolving society with demands for generic and lifelong learning skills. Together, these approaches illustrate how different innovative approaches reflect different ways of departure for researchers working within the fields of design and play as well as design for learning.

The first perspective adds a focus on the environment and spaces based on ecological understanding of design and learning with a pivot point on boundaries and people's wayfinding. The perspective addresses a macro level of people's engagement in the world and thus in design and learning processes. The perspective offers a deepened understanding of learners' learning process in and across spaces and places and in the intersection between.

The second perspective adds a focus on activities with artifacts and people's engagement in creative and playful processes of making and breaking as part of a design and learning process. This perspective expands the first by adding a meso and micro level looking into how concrete playful designs can afford children's and other people's exploration, problems solving and creation of new knowledge.

The third perspective takes the position of collaborative design in educational settings from a meso perspective, with a focus on context and sequences, framing and fixing points, and on the choice of material and semiotic resources to express/represent knowledge. Learning is thus understood as a collaborative, creative process of developing meaning and understanding by way of sketches and pattern designs.

To conclude, we started out by saying that digitalization not only changes ways of learning, but it also challenges conditions for creativity in different landscapes of learning, where a making and creating culture can expand on people's knowledge acquisition. Through the three different perspectives, we illustrated how innovative designs and learning in analogue and digital activities can promote new metaphors, theories, and methodologies to study these kinds of processes. Despite their differences, the three perspectives on design, learning and innovation presented in this paper can be used in different educational practices to understand people's engagement in design and learning. Expressed differently, these perspectives share similarities by moving beyond an understanding of design and learning as fixed processes.

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