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Almost Risking It All: Non-calculable Risk-taking and Design Education

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This paper provides an argument against understanding risk-taking in design education as something ideally in need of only being calculable and formalisable. Using the German sociologist Ulrich Beck's theory on risk-taking combined with the current discourse on design thinking, together with an analysis of a three week-long interdisciplinary design workshop, we analyse and discuss how risk-taking - as a general concept - in design education is an inherent element of the education itself. We argue, however, non-calculable risks, like human-centred design concerns, like desirability of use, ethics of technology, are an equally important part of a modern-day educational skillset as calculable risks. The aim is arguing for the prospect of interdisciplinary design-based education models as one way of embracing the non-calculable elements of a problem space.

#design education

#computational thinking

#non-calculable risk-taking

#risk society

Introduction

In 2017 Christina Redecker and Yves Punie published an EU report on computational thinking: European Framework for the Digital Competence of Educators, in short DigCompEdu (Redecker 2017). Here they presented an elaborate framework for teaching and learning computational thinking using digital tools to do so. The framework exemplified how educators should use digital tools to guide, apply, and assess computational thinking skills in their teaching and in students. The argument was increasing the development of computational thinking skills in learners because these skills were seen as the key twenty-first century skill set.

In this article, we will challenge this framework and the idea of computational thinking as the predominant key skill set for the twenty-first century. We argue for a wider range of skills, including a design-oriented focus on non-calculable risk-taking, to prepare education for the complexity of today's society. Setting out with a definition for risk-taking, we discuss the need for risk-taking in teaching and learning. This includes the embracement of non-calculable outcomes of social and cultural problems, often assigned the label of being 'wicked' (Kolko 2009).

The aim is not to challenge the idea of risk-taking in design education per se. Rather we acknowledge it as an equal component in an academically rigorous contribution. However, we will challenge the idea of seeing computational thinking as *the* method for handling risk (by either avoiding it or making it calculable) through the ideals of formalised knowledge alone. Some phenomena, while dealing with technology, cannot easily be formalised through either inductive pattern recognition or deductive algorithmic thinking, as often heralded in computational thinking discourse (Wing 2008). While frameworks like DigCompEdu are useful, especially in adding informatics to a given academic setting, it is inadequate for the solving of wicked design problems with no single optimal solution. Here, inductive patterns and deductive causality primarily exist to inform the 'qualified guess' of new ideas, framings or re-interpretations of previous dogmas. This is driven by an abductive logic, not easily formalised through computational thinking, but is expressed rather through iterative and creative experimentation with incomplete patterns and human experiences, which to a much higher degree, contain the need for 'risking' to be wrong (Kolko 2009). The need to take risks, the ability to work together in groups, the ability to pitch a project, and present deep reflections, and in the end discard it all as part of a 'designerly' process are skills all needed in the complex society that is developing around us. While these might be included alongside computational skills, we argue these skills need to be acknowledged as possessing their own academic merits to a great extent due to dealing with how they handle risk-taking.

In the next sections we will clarify the problem hinted at in the introduction, focusing on, first, a general challenge connected with the educational ideas behind The European DigCompEdu: that it doesn't embrace a sense of non-calculable risk taking, thus it is not able to incorporate creative skills like design thinking on its own terms. Second, we trace the development of design emphasising its dealing with non-calculable risktaking. Third, we will relate this to Ulrich Beck's (1992) notion of risk society. Fourth, we will use a three-week design workshop, U-CrAc, at Aalborg University, Denmark, as our case study. The workshop has been conducted since 2010 with varying setup and outcomes. We have presented the structure and overall purpose of the three latest workshops, comparing this against the DigCompEdu framework.

Clarification of Problems

Risk-taking and management of risk can be considered part of many, if not all, creative processes,

including both scientific, artistic and design processes, and, in a broader sense, a condition of our current society. The latter points towards dealing with risks, or uncertainties, in different ways and in different contexts, but often, and wrongly so, considering people's behaviour when dealing with risks as uniformly operating with a calculable uncertainty. This, for example, is part of the assumption within social sciences focusing on decision-making without perfect information. Chance becomes part of the conditions for decision-making, but it is minimised by calculating, often statistically, the risks of different scenarios (Hacking 1990; Elster 2007). However, a significant part of risk-taking is non-calculable, i.e. cannot be dealt with using ratiocination and formal methodologies. Instead, it involves the practical use of imagination, is contextual, and often resembles an abductive mode of inferring from incomplete data sets into conclusions outside the premises of the boundaries of said data. However, it is not, as Jaz Choi et al. (2018) claims, a matter of deploying risk-taking within university courses dealing with creativity. Risk-taking needs to be understood as a creative endeavour in itself. It is this latter concept of risk, we will claim, is needed in art and design education, which fails to be captured in the EU report mentioned above, and is the subject of discussion here.

In the European DigCompEdu framework, the main proficiency keywords are directly related to Bloom's taxonomy (Redecker 2017, 29). The six main steps for the educators are awareness, which defines the newcomer and explorer whose mindset should be defined by curiosity and willingness, turning into the second step, exploration, which is defined by meaningful use and variation of the digital technology involved in teaching. The third step denotes integration whereby digital technology is used as a strategy and diversification. The fourth step is expertise, which includes reflection on and the sharing of digital tools, turning into leadership as the fifth step. Here, the educator becomes a creator and a critic, not of the digital technology itself but on how other educators use the tools provided. In the final step of Bloom's developmental ladder, the leader turns into a pioneer becoming an innovator.

While DigCompEdu defines the pioneer educator as critical of digital technologies, this critique is only used to assess digital tools for their proficiency in teaching, assessing, and supporting learners in self-directed learning (Redecker 2017, 19). Like in the fifth step, the pre-given digital technological framework is not questioned. Thus, whatever use is developed – including any risk taken – is defined within this framework. The framework mentions risk several times (Redecker 2017, 23, 25, 84, 85), but always with the aim of managing it. Hence, it is a calculable risk, a risk to be reckoned with.

To achieve the highest levels of proficiency, DigCompEdu identifies 22 elementary competencies, organised into six main areas: professional engagement, digital resources, teaching and learning, assessment, empowering learners, and finally, facilitating learner's digital competence (Redecker, 2017, 15). All of this should be achieved by using computational thinking methods. Some organisations, such as the British 'Barefoot Computing' (2018), include 'soft skills' like 'collaboration', 'persevering' and 'tinkering' alongside the formal skills, e.g. 'algorithmic thinking' and 'decomposition', in their computational thinking framework. However, the descriptions and use of the soft skills are still often directed towards their support of the formal and rational treatment of a given problem. Only rarely are soft-skills emphasized as something with its own merits, able to spark critical reflections emphasizing non-formal aspects such as ethics, usefulness, and desirability.

This brief discussion of DigCompEdu indicates a number of general points in need of scrutinization when a turn to reliance on digital technologies

understood as formal educational methodologies is taking place. First of all, it presents a one-dimensional picture of the use of digital technology because it fails to consider the value of dispersed and non-formal risk-taking by both learners and educators. So, any notion of risk-taking defined within a specific (formal) digital framework, is thereby delineated by what the formal methodology allows, and unable to 'risk' incorporating anything relevant but outside of what the methodology delineates. Second, and related to the first, critical thinking is not encouraged. One consequence is that technological thinking – here computational thinking as a formal method for dealing with problems, but it could also be a sole focus on statistical inferentiality— is seen as the positive and only solution to a proper education for the 21st century, and not as related, as a supplement or complementarity, to other means of education. Applying design thinking, for example, would entail a critical assessment of design processes and their solution(s). Any design of a product (material or immaterial) carries the risk of non-use with it. The use of a design influences the user, as design itself designs the user, and the user influences the design through its use. Thus, evaluation of such problems, and their possible solutions requires critical thinking skills as a designerly approach, addressing the interaction between design and user.

So, what we will be proposing here, is to "expand" or contextualise the DigCompEdu in the following way. As the DigComEdu paper argues (Redecker 2017, 12), there is a need for competences using digital technologies critically and creatively. We agree, but our argument points to a shortcoming in the understanding of the conceptions of being critical and creative. Assessment of a problem, by a learner, or an educator should be conducted not only by adhering to formative and summative digital tools. Rather, the learners should get feedback – including critique - from relevant contexts including users like companies or end-users besides academics. Empowering learners through digital activities puts the onus on the individual. Our complex society requires learners to be able to work in groups, as well as using technology to solve real-world problems and challenges.

In designing design education, one thing is to argue for design as a valid supplement to computational competencies, but this also needs to be understood through the lens of the challenges of fitting design into academic programs of higher education. This is to be seen in the light of the on-going debate about how to frame design as its own independent research paradigm (Gaver 2012). In the early 1980s Nigel Cross (Cross 1982) argued how design was placed between the fields of natural sciences and the humanities. This distinction was rooted in Wilheim Dilthey and Ramon Betanzos' (Dilthey 1988) division between the natural scientific study of observed (positive) phenomena, explaining these phenomena's causal relation to other phenomena, and the humanities and social sciences interpretative studies of the lived human experiences on both an individual and societal scale. In contrast to these two major scientific fields, Cross argued, design had its own pursuit of knowledge about man-made phenomena. This was further emphasised by Richard Buchanan (Buchanan 2001) defining design as the synthesis of 'products', as well as relating to Herbert Simon's oft-quoted broad view of design as a 'science of the artificial'. In addition, Alessandra Deserti and Francessca Rizzo (Deserti and Rizzo 2014) has detailed this further, separating engineering design from human-centred design and understanding this as a division between studying the man-made in 'a world of limits' (engineering), and a world of 'opportunities' (human-centred design). Recently, 'design thinking' has emerged as a near omnipresent term in the field. It is separated from engineering by emphasising man-made products as concerned with the world as it 'could be' (Kolko 2009), and not to be inferred from its premises to something which 'must happen'. This indirectly

relates engineering to the causal explanations of natural science, and human-centred design as primarily related to the interpretive traditions of the humanities and social sciences. These roots of design thinking are further supported by Buchanan's inclusion of the social planning terminology of 'wicked problems' (Buchanan 1992), where design is framed as "...a new liberal art of technological culture". More recently, (Kolko 2011) has also argued for design as a new liberal art. He argues that in our current technological culture, the focus on user experiences is on par with earlier critical ideological considerations found in arts and craft practices.

When scrutinised, it is clear that due to the continuum between design engineering and human-centred design, attributes from the former are also found in the latter. As Peter Krough, Thomas Markussen et al. (2015) and Ilpo Koskinen et al. (2011) have indicated, substantial parts of design research as well as design thinking are, in one way or another, concerned with the instantiation of 'experiments', i.e. as an active intervention forming a product synthesis to be experienced and interpreted. Design experiments are argued to contain both convergent and divergent logics with construction seen as a knowledge production in its own right, and emphasising the process just as much as the end-product (Krogh et al. 2015). Historically the experiment has played a much less significant role in the humanities than in the natural sciences. Until a few decades ago, the humanities research foci on design was mainly an idea-historical inquiry into and study of the aesthetics of the artifacts produced by the arts and crafts fields (Buchanan 2001). Only in recent decades, with the arrival of design thinking, has the constructive practice of design found its way into the humanities as an area of academic interest.

This has led to an increase in fields seeking to include design thinking into their disciplines and research programmes. Klaus Krippendorff (Krippendorf 2005) pointed to more than 650 different areas relating themselves with or claiming a strong kinship to that of design. But if design can be seen as an addition to a wide range of practices, is design then always to be considered adding the same value? Furthermore, in a cross-disciplinary perspective, how can the knowledge contributions of one academic programme be substantiated, extended, or critically evaluated, through either the scope of design or with design as an addition to a different discipline? Unlike pedagogical challenges within 'traditional' design schools, these intertwined problems emerge and pose a risk-taking for students in academia. This is because design is often seen here as an 'addition' to be adjoined and merged into the traditional academic treatment of their field - much in the same way as the DigCompEdu framework proposes it for computational thinking. Hence, while design has been recognised as a softskill in higher education, this poses the challenge of how students balance the core curriculum with the added design and computational thinking skill sets, often differing from the core curriculum.

This implies several challenges: managing the risk of either focusing on solving the problem presented, perhaps downplaying academic reflection in the process, or meeting the academic requirements, but then often lacking the time dealing with the design problem in depth. Students capable of aligning the academic theoretical, and the practical design or artistic part, often manage risk in an imaginative and contextual manner, but as teachers, we are often incapable of explicating how this alignment can be made or taught. At least we cannot, as the DigCompEdu proposes, present a taxonomy with predefined appertaining methods the following of which will ensure problem-solving.

This is probably one consequence of risks being non-calculable, i.e. we cannot design didactics ensuring the desired effect beforehand. Learners

have to rely on a combination of design and critical thinking, with the application of computational thinking as yet another method. The three methods together, on par with each other, can guide a particular inquiry. This implies also that the logic of neither critical, computational, nor design thinking, are self-sufficient. Rather these are to be seen as complementary skills necessary for risk-taking in modern educational and practice settings. This, however, begs the question of how to establish a suitable didactics and pedagogy teaching risk-taking to students.

To answer this question, we now elaborate on Ulrich Beck's (1992) notion of risk-society, and what this generally means for education.

Risk Society and Its Implications for Education

As Steven Bialostok et al (2012, 8ff) claims, studies of risk usually fall in three categories. One focusing on the understanding of risk in other cultures using ethnographic methods (Douglas 1966; 1992), the second inspired by Foucault's notion of governmentality addressing risk as a (socio-politico-economic) power (Dean 1999). Both are relevant and could potentially be used to expand this study. However, our concern here is neither foreign cultures nor conceptions of power, but risk as a modern societal condition for education, i.e. dispersed between conditions internal and external to education, implicitly uncontrollable. Hence, we will focus on the third, namely Beck's risk society.

The notion of risk society was first promoted by the German sociologist Ulrich Beck (and later in collaboration with the British sociologist Anthony Giddens) who in 1986 presented the notion in a book by the same name *The Risk Society*. The idea revolves around the development of late western modernity, what Giddens terms post-traditional society, with the concept of risk and risk management attaining a different and more prominent role than previously.

Modernity, Beck argues, has undergone a process becoming increasingly reflexive (Beck 1992, 155). While the industrial phase of modern society (from approximately 1860 onwards) showed a rapid change in development of technology and production, thereby creating radical transformations in everyday life of people, it still contained less obviously a dependency on traditional social forms, like gender, work and family roles, within a fairly stable and traditional stratified class society. This changes in the middle of the twentieth century, transforming family structures, employment patterns and welfare provisions, thereby redrawing class boundaries and social identities. To give an example, the increase in women being part of the labour market after World War II, presented a challenge for traditional gender roles as well as family structures, which were transformed in the process. Furthermore, with the increasing dissolution of traditional social structures, a predominant individualisation takes over instead. Without pre-given meaningful structures to rely on, each person is left with the task or burden of creating meaning by and for themselves; of responding to different situations through a reflexive process relating themselves to these situations in a meaningful way. Thus, modernity becoming more reflexive implies that any preconceived notions of how our society is supposed to be understood are questioned. Modernity becomes second modernity, as Beck terms our present time, since it is confronted and forced to deal with itself (Beck 1994). Using the concept reflection in reflexive modernity, is therefore also related to reflection as when one looks into a mirror: we are confronted with the (potentially unknown) results and consequences of our own making (Sørensen 2018, 6).

In terms of risks, we can therefore understand the change in society as follows. Before the onset

of industrial society and its recent development, risks were part of a human condition through the occurrence of natural hazards (like diseases, floods, and famine, etc.) as well as human induced hazards like invasion and wars, oppressive forms of thought and culture, and rigid class structures. With industrial society, risk becomes increasingly human-induced as a consequence of our technological mastery over nature. The risks we now face are predominantly results of our own actions. As in the description of design above, this is related to the world of limits, risks related to the concrete physical design, as well as the world of opportunities, being the possible risks related to what can become.

At first these risks were merely local, like the factory-related or occupational hazards following the beginning of industrialisation in the nineteenth and the beginning of twentieth century. Since then, however, they have become more global in character, cutting across the previous stratified society (Beck 1992, 13). One example here is industrial pollution. It is a result of our own making, and in a globalised society, it affects poor and rich, healthy and sick alike. Beck puts it this way that whereas "poverty is hierarchic, smog is democratic" (ibid., 36). The risks we face today are both like the pre-industrial risks, in that we are exposed to them and cannot avoid or guard us against them. But they are also unlike these pre-industrial risks, since they are either man-made or results of what we have done.

Risks then, pertain to society as a whole, and hence also to education. As Bialostok (2015, 561) claims, "Risk lives in and through educators, students, and the policies that govern them at local and national levels, independent of political ideology or party affiliation."

One example of this is the plentitude of educational reforms after the financial crisis, supposed to ensure the determinedness of education towards the demands of the labour market. And as a management of risk, it is independent of political ideology or party affiliation. The latest example of this is the implementation of educational policies in compliance with the DigComEdu report referred to above, across, for example, the European Union. National governments have put into effect an initiative developing and implementing computational thinking skills in kindergartens as well as in high school and university settings, e.g. Danish government (Danish Ministry of Education 2018). And as the analysis of DigCompEdu above shows, the aim here is to reduce risk in education, learning, and teaching through computational thinking as calculated risk-taking.

Whereas the above indicates the importance of a wider societal context of understanding risk and its relation to educational institutions —we could have delved into the neo-liberal economical side as well (Olsson and Peters 2005; Carter 2010) —we also need to consider how risk-taking and the management of risk are internal parts of educations and educational processes, without being reducible to a sole response to demands from the wider societal and political context. Our example of a design module, presented in the next section, will try to capture the complexity in risk-taking as related to external societal and internal conditions. Furthermore, this risk-taking is framed through three theoretical orientations: computational thinking, design thinking and critical thinking; the three of them understood as complementary.

Case: The User-Driven Creative Academy Workshop

One example of the challenge of merging the students' critical reflection on previous and current theories, artworks and designs, and creating a practical design, is the course module Agile Concept Development in a Design Research Perspective at Aalborg University (2018). The course

module is described, analogously to descriptions of traditional course curricula at Aalborg University, in a standardised regulatory form depicting what knowledge, skills, and competency the students will acquire upon finalising the course. However, a major part of the module is executed as a practice-oriented design workshop called The User-Driven Creative Academy (U-CrAc 2018). This workshop is an annual event, with approximately 150 students from different education backgrounds coming together in a three-week interdisciplinary design sprint working with a series of cases from Danish industry companies (Vistisen et al. 2016, Nielsen and Poulsen 2016). The workshop is built upon Aalborg University's model for problem-based learning (PBL), implying the cases represent authentic real-world problems. These then serve as objects of design challenges, where the theory and methods of the different educations can be put into practice. This is framed through an introduction to general theories and methods of user-centered design, gradually being presented to the students as they progress through the three weeks of the workshops' phases: 1) fieldwork, 2) ideation and 3) concept development. Typically, the industry case partners challenge the students to work on an open-ended challenge and not demand a specific solution. Hence, the students are encouraged to explore the foundation for the problem formulation itself, and devise their own innovative strategy for dealing with the problem.

Prior to the workshop, and before being merged into inter-disciplinary groups, the different students receive discipline-specific courses aimed at their specific educational 'role' in the workshop. As an example, students from the participating entrepreneurial engineering programs receive specific teaching about business modelling, while students from a participating humanities program receive courses in interpreting qualitative data sources. Meeting each other in the interdisciplinary workshop then challenges the students to put their programme specific knowledge into play together with the design-oriented shared theories and methods from the workshop. The idea here is to avoid the calculable risk-taking of focusing solely on either the programme- specific knowledge or the design-oriented practice, but instead seeing it as an interplay between multiple and different strategies, with the process leading to a possible compromise or alignment becoming a natural inbuilt constraint. Hence, instead of managing risk by either focusing on solving the problem presented, or adhering to one's specific academic repertoire, the students are challenged continually to reflect on and articulate why a given knowledge domain's theories and methods are, or are not, appropriate in the given situation. Adding the external 'push' of the industry case partner, and the time limit of three weeks to the process of reaching a compromise, these risks are made very explicit. This is especially interesting since the workshop only involves a limited amount of written reflection. Instead, the experience of risk-taking and the making of compromises within a context comprising the clashing of different kinds of academic knowledge with other knowledge domains and the constraints involved in practice-oriented problem-solving is emphasised. This cannot be understood as a form of calculated risk as described above, i.e. using a ratiocinative procedure or a specific method for dealing with the uncertainties encountered through the process. Rather, this is more akin to the idea of creative risk-taking presented by Choi et al. (2018) developing a contextually related sensitivity through the practical use of imagination. However, against Choi et al. (2018), this is not a matter of conjoining risk-taking with some technique of creativity. Instead, students engaged in the process learn that the risk-taking involved in aligning different kinds of knowledge from different domains is a creative process in itself. The experience teaches them that is it a non-calculable process, since no specific method is capable of paving the way to the solution, the outcome

cannot be predicted (failure is a possibility) and the choices made along the way depend in each case on developing a continual acuity mediating a sensitivity of context and practical use of imagination in how to proceed next.

After the workshop, the students are met with one last intervention, inspired by Donald Schön's (Schön 1983) notion of 'reflection-on-action'. The students are tasked with looking back at the decisive moments of making compromises, risk-taking, and breakdowns challenging them throughout the workshop, and annotate these with the core curriculum from their specific academic programmes. This 'Day of Reflection', in Beck's sense, consists of the students re-reading the academic sources, for example, design-oriented pragmatism (Dalsgaard 2014) and phenomenology (Cross 1999) to critically assess their own workshop process. The goal here is to show that while the risks in the design workshop are non-calculable, the academic analysis of creating these post-reflections is ensuring a level of transparency to the design practice. Classic academic critical virtues are here treated as an equal output alongside the practical work done with the industry case partners in the workshop. This reflection-on-practice, of how the design-oriented didactics met (and clashed) with the programme specific theories and methods of the students are thus one way of acknowledging risk-taking to the students.

Discussion

One important aspect of risk-taking in art and design education is thus dealing with uncertainties. This is probably also a better way of capturing the overall sense of risk that Beck wants to express, because he, in contradistinction to the traditional academic way of interpreting risk as a statistically informed calculable uncertainty, wanted to understand risk as non-calculable uncertainty (Sørensen 2018, 6). In relation to design education and our example above, the important term here is non-calculable, i.e. cannot be dealt with using one method only, including formal methods like computational thinking. Instead, risk-taking involves some sort of practical use of imagination (related to the internal condition of art and design education) and is contextual (it includes reflection on different external conditions).

Choi et al. indicates what conditions must be present in an art and design educational setting for non-calculable risk-taking, or creative risk-taking as they term it, to thrive. First, it depends upon an open and playful learning environment encouraging both sharing and the critiquing of multiple perspectives. Second, students need an adequate period of time developing and revising creative concepts. And third, the students need opportunities to evaluate their own performance in developing creative risk-taking capacities (Choi et al. 2018, 4). The role of the educator here is supporting "flexible ways of learning to achieve a balance between critical thinking and creative innovation."(ibid.) We recognise here an aspect of the dilemma presented above, between focusing too much on the critical academic part, downplayed perhaps because of lack of time, the development of concepts and design, versus focusing on problem-solving without accompanying academic reflection. How do we as educators ensure a proper balance between academic reflection and time for immersion in designing?

Well, in general, not by understanding critical thinking as non-creative, and creative innovation as non-critical. During the U-CrAc workshop, the students are confronted with the consequences of the risks they have taken, making it an example of what Beck termed reflexive modernity. Firstly, it underlines the lack of a pre-given overall structure of meaning for the students to consult when dealing with the design challenge. An alignment of their separate knowledge foundations where effectuated, creating an ongoing

compromise-seeking process, similar to a dialogue. Secondly, without this overall structure of meaning, for example, through the use of one single method (which is more like a monologue), a certain individualisation takes over. This occurs on two levels. First, each member of the project team has to contribute meaningfully to the task at hand, invoking their personal academic experience. "Can this method be used here? How is my use of this theory or method different from how others in my project group use it, and how are we to relate it to the challenge before us?" Reflections like these help the creation of meaning for group members individually but also for the group as a whole. Second, the project group itself becomes individualised as well. The reflection-on-practice creates a space where the group as a whole reflects on what they have done in particular, to problematise and solve this particular design challenge. The reflection then, becomes the mirror which is alluded to in Beck's notion of reflexive modernity: it is the mirror where the students are confronted with the results of their creation, the choices made through the process leading up to it, and the justification of aligning all the different interests and knowledge being part of this process as well. U-CrAc, then, exemplifies how an educational course works with a concept of non-calculable risk-taking, which is reflexive in factum as well as post-factum.

Conclusion

In this paper, we have posed a number of questions concerning risk-taking and design education. Using an example from Danish design education, we have presented a case for considering non-calculable risk-taking as a highly important part of an interdisciplinary perspective including design. We argued against the recent trend of DigComEdu replacing risk-taking with (computational thinking inspired) methods reducing any uncertainties necessary for students to learn. As frames supporting this claim, we presented firstly, an interpretation of the development of design, understanding the risk-taking of students as aligning the academic reflection based on the core curriculum with the thinking of design. Secondly, we related this to Beck's notion of risk society, and the challenges it poses to education. To exemplify this, a design course U-CrAc from Aalborg University, where non-calculable risk-taking is an important part, was presented and discussed. This indicated that future policymaking related to design educations similar to DigComEdu, need to address and include considerations of the inherent non-calculability and abductiveness of design besides the formal and computational skills, to ensure the readiness of modern higher education when dealing with the challenges of the twenty-first century.

Bibliography

Aalborg University. "Interaktive Digitale Medier" Aalborg University. Retrieved October 22, 2018. from https://www.aau.dk/uddannelser/kandidat/interaktive-digitale-medier/

Barefoot Computing. "Computing At School." Updated 2018. Retrieved October 22, 2018. https://barefootcas.org.uk/.

Beck, Ulrich. *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*. Oxford: Polity Press, 1994.

Beck, Ulrich. *Risk Society*. London: Sage Publications. 1992.

Bialostok, Steven, Robert L. Whitman, and William S. Bradley. *Education and the Risk Society*. Rotterdam: Sense Publishers, 2012.

Bialostok, Steven. "Risk theory and education: Policy and practice." *Policy Futures in Education 13*, no. 5 (2015): 561-576.

Buchanan, Richard. "Design Research and the New Learning." *Design Issues 17*, no.4 (2001): 3–23. https://doi.org/10.1162/07479360152681056.

Buchanan, Richard. "Wicked Problems in Design Thinking." *Design Issues 8*, no.2 (1992): 5–21. https://doi.org/10.2307/1511637.

Carter, Lyn. "Neoliberal Globalization and Learner-Centred Pedagogies: Posing some Different Questions." *Canadian Journal of Science, Mathematics and Technology Education 10*, no.3 (2010): 223-231.

Choi, Jaz, Payne, Alice, Phoebe Hard, and Alice Brown. "Creative Risk-taking: Developing Strategies for First Year University Students in the Creative Industries." *International Journal of Art and Design Education 37*, no. 3 (2018): 1-17.

Cross, Nigel. "Designerly ways of knowing." *Design Studies 3*, no. 4 (1982): 221–227. https://doi.org/10.1016/0142-694X(82)90040-0.

Cross, Nigel. "Design Research: A Disciplined Conversation." *Design Issues 15*, no. 2 (1999): 5–10. https://doi.org/10.2307/1511837.

Dalsgaard, Peter. "Pragmatism and Design Thinking." *International Journal of Design 8*, no. 1 (2014): 143-155.

Danish Ministry of Education. "Undervisningsministeren vil gøre teknologiforståelse obligatorisk i folkeskolen." Updated 2018. https://uvm.dk/aktuelt/nyheder/uvm/2018/jan/180126-undervisningsministeren-vil-goere-teknologiforstaaelse-obligatorisk-i-folkeskolen.

Dean, Mitchell. "Risk, calculable and incalculable." In *Risk and sociocultural theory: new directions and perspectives*, ed. Deborah Lupton (Cambridge and New York: Cambridge University Press, 1999): 131-159.

Deserti, Alessandra, and Francessca Rizzo. Design and the Cultures of Enterprises. *Design Issues 30*, no.1 (2014): 36–56. https://doi.org/10.1162/DESI_a_00247.

Dilthey, Wilheim. *Introduction to the Human Sciences: An Attempt to Lay a Foundation for the Study of Society and History*. Translated by Ramon J. Betanzos. Detroit: Wayne State University Press, 1988.

Douglas, Mary. *Purity and danger. An analysis of concepts of pollution and taboo*. London: Routledge, 1992.

Douglas, Mary. *Risk and blame*. London: Routledge, 1960.

Elster, Jon. *Explaining Social Behaviour*. Cambridge: Cambridge University Press, 2007.

Gaver, William. "What Should We Expect from Research Through Design?" Paper presented in SIGCHI Conference on Human Factors in Computing Systems. Austin, TX, May 5-10 2012.

Hacking, Ian. *The Taming of Chance*. Cambridge: Cambridge University Press, 1990.

Kolko, Jon. "Abductive Thinking and Sensemaking: The Drivers of Design Synthesis." *MIT Design Issues 26*, no. 1 (2009): 15–28. https://doi.org/10.1162/desi.2010.26.1.15

Kolko, Jon. *Thoughts on Interaction Design*. Elsevier, 2011.

Koskinen, Ilpo. *Design research through practice from the lab, field, and showroom*. Waltham, MA: Morgan Kaufmann, 2011.

Krippendorff, Klaus. *The Semantic Turn: A New Foundation for Design*. Boca Raton, FL: CRC Press, 2005.

Krough, Peter G., Thomas Markussen and Anne L. Bang. " Ways of Drifting—Five Methods of Experimentation in Research Through Design." In *IcoRD'15 – Research into Design Across Boundaries Volume 1*. New Delhi: Springer India, 2015.

Nielsen, Lousia M., and Søren B. Poulsen. "The User-Driven Creative Academy." Paper presented an the 18th International Conference on Engineering and Product Design Education, Aalborg, Denmark, 8th-9th September 2016.

Olssen, Mark, and Michael Peters. "Neoliberalism, higher education and the knowledge economy: from free market to knowledge capitalism." *Journal of Education Policy 20* no. 3 (2005): 313-345.

Redecker, Christine and Yves Punie "European Framework for the Digital Competence of Educators: DigCompEdu." Publications Office for the European Union, Luxemburg, 2017.

Schön, Donald. *The Reflective Practitioner: How Professionals Think in Action*. Basic Books, 1983.

Sørensen, Mads P. "Ulrich Beck: exploring and contesting risk." *Journal of Risk Research 21*, no.1 (2018): 6-16.

User-Driven Creative Academy. "Innovation Workshop." Aalborg University. Updated in 2018. Accessed October 22, 2018. http://ucrac.dk/.

Vistisen, Peter, Thessa Jensen, and Søren B. Poulsen. "Animating the ethical demand: exploring user dispositions in industry innovation cases through animation-based sketching." *ACM SIGCAS Computers and Society 45*, no. 3 (2016): 318–325. https://doi.org/10.1145/2874239.2874286.

Wing, Jeanette. "Computational thinking and thinking about computing." *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences 366*, n.1881 (2008): 3717–3725.

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