

CROSSING CULTURES: CREATING A PH.D. PROGRAMME IN ENGINEERING, ART & DESIGN

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ABSTRACT.

In this paper, challenges and potential rewards of multi-disciplinary cooperation in engineering and design education are discussed with reference to the specific case of developing a joint PhD program in technology, engineering, art and design at Oslo and Akershus University College of Applied Sciences. A point of departure for the discussion is C.P. Snow's identification of a conflict between two academic cultures: science and humanities. Snow argued that the mutual ignorance of the other group's world view had become a direct hindrance to our ability to cope with the grand challenges of the future, such as famine, overpopulation and poverty. Today, more than 50 years later, Snow's pessimistic diagnosis has still not lost its relevance. Cooperation and genuine understanding across disciplinary boundaries is encouraged, but seldom realized. The paper describes the current status of a multi-disciplinary PhD program in development in which Responsible Research and Innovation (RRI) is applied as a unifying, program defining perspective. Explaining how RRI may attend to needs and shortcomings in both academic cultures, the supplementary method of "critical making" is introduced and discussed. The main content and structure of the program is presented, before a final evaluation of the challenges, potential risks and rewards of venturing into such a contested territory is offered.

Keywords: Multi-disciplinarity, PhD education, the two cultures, cultural innovation and sustainability, responsible research and innovation (RRI)

1 INTRODUCTION

In his lecture on *The Two Cultures* published in 1959, writer and scientist C.P. Snow addressed the need for cross-disciplinary approaches in order to solve the world's grand challenges of famine, overpopulation and poverty. At the same time, he acknowledged that the lack of understanding – even hostility – between scientists on the one hand, and "intellectual" humanists on the other, had never been more apparent [1]. The mutual ignorance of, and disinterest in, the other group's perspectives on the world was identified as a direct hindrance that had to be overcome, should we be able to cope with the challenges of the future. More than 50 years later, Snow's predictions are as relevant as ever. Issues of sustainability, responsible research and innovation (RRI), and universal accessibility are prevalent in technological and scientific discourses, policy documents and research program calls at national and international (EU) level. These are all approaches that require cooperation and the exchange of ideas, perspectives and methods across disciplinary boundaries, combining the technical competence and progressive force of the sciences and the applied sciences with the critical awareness, context sensitive and user-oriented approaches of the humanities, social sciences and the arts. Obviously, there is need for combined, multi-disciplinary approaches in order to grasp the complexity of today's and tomorrow's grand challenges; however, is there will?

In an oft-quoted passage of his lecture, Snow described how scientists were expected to be familiar with at least the most central classical art works of their culture, while humanists tended to take pride in their ignorance of even the simplest matters concerning science [1]. Sadly, not much has improved in this regard within the humanities camp since 1959. Equally sad is the development within scientific communities, where familiarity with the classical works of theatre, art and literature is hardly considered a virtue anymore. Arguably, the severity of Snow's recognition of the knowledge gap and

mutual lack of interest between scientists and the humanities and arts has never been more evident than in our present competition-driven academia where humanities subjects are closing down, one after the other, to make space for more market-oriented, instrumental and profitable subjects in the field of technological innovation.

One could argue that in this situation, humanities subjects and cultural critique become incredibly important areas to nurture and preserve, as they may form a modifying counterweight with which to balance technological progress. Critical thinking; user-oriented methods and perspectives; participatory design; as well as methods and ideas of cultural sustainability may be invaluable assets in the development of healthy and sustainable technological solutions intended to serve human users. This is one argument motivating and informing our attempts to develop a multi-disciplinary PhD program at our faculty, covering the fields of technology, engineering, art and design. In this paper, I will present the overarching idea and motivation behind the program, its content and structure, and discuss some of the challenges we have encountered in the development process.

2 MOTIVATIONS AND PERSPECTIVES

The Faculty of Technology, Art and Design is presently the only faculty at Oslo and Akershus University College of Applied Sciences without an educational program in the third cycle (PhD level) to offer its students. This is experienced as unfortunate, not least because technology is defined as an area of particular importance in the university college's recently decided strategy plan. The faculty has therefore been encouraged in its plans to develop a PhD program in which one of the components should be digital technology. A project group of nine persons (including the author) representing a variety of disciplinary perspectives has been engaged in the task since February 2016, and the development work is still in progress.

The faculty encompasses five departments: Dept. of Civil Engineering and Energy Technology; Dept. of Art, Design, and Drama; Dept. of Mechanical, Electronics and Chemical Engineering; Dept. of Computer Science; and Dept. of Product Design. Together they cover a wide range of educational disciplines and subjects, and represent at least the two cultures identified by Snow, if not more. In order to reconcile these cultures in a joint PhD program, a significant part of the process has been to accept and adapt to different ways of thinking. Naturally, in this process of negotiation, ways of combining arts and engineering that appeared relevant, even alluring, to some members of the project group, have been perceived as less relevant by others. While in some areas, fundamentally different value systems and motivations have been identified that exclude potential courses for collaboration, common ground for productive cooperation have been found in other areas. For example, from the arts and humanities perspective, combining art, design and technology in a joint program focusing on the creative potential of technology was an appealing thought, regarding the artist as an innovator, and the engineer as an artist in her own right [cf. 2]. However, through discussion it became apparent that from an engineer's perspective, this idea did not comply well with the basic requirement that the PhD program be perceived as relevant to and by the professions to which we are educating candidates. Focusing instead on how the program could fulfil its role as relevant both to society and the involved professions, we landed on the multi-disciplinary perspective of Responsible Research and Innovation (RRI) as our defining concept.

2.1: Responsible Research and Innovation (RRI)

Representing a cross-cutting issue in Horizon 2020, RRI is presented as follows:

“Responsible research and innovation is an approach that anticipates and assesses potential implications and societal expectations with regard to research and innovation, with the aim to foster the design of inclusive and sustainable research and innovation. Responsible Research and Innovation (RRI) implies that societal actors (researchers, citizens, policy makers, business, third sector organisations, etc.) work together during the whole research and innovation process in order to better align both the process and its outcomes with the values, needs and expectations of society. In practice, RRI is implemented as a package that includes multi-actor and public engagement in research and innovation, enabling easier access to scientific results, the take up of gender and ethics in the research and innovation content and process, and formal and informal science education.” [3]

On a surface level, technology today is developing more invisible, ubiquitous and intuitive in use, heading towards a frictionless integration in our everyday lives. Its deeper, structural levels do however appear increasingly complex, unmanageable and out of reach to its users. Also in this perspective, Snow's warning of the unfortunate consequences caused by the lack of communication between the two cultures – the sciences, on the one hand, and the humanities, on the other – is a striking depiction of the situation today. For how can humanists, artists and designers maintain their relevance as cultural critics in an increasingly “smart” society, without a basic understanding of science and technology?

However, not only humanists may be losing touch with the inner workings of technology today. In their article, “What Is ‘Responsible’ about Responsible Innovation?”, Alexei Grinbaum and Christopher Groves explain that when the internal functioning of a technology is experienced as opaque and out of the layperson's reach, it may become “naturalized” to the extent that it is perceived as autonomous. To an increasing extent, they warn, the development of technology today threatens to escape even the engineers' control: “The more complex our technologies become, and the more embedded in the social and natural worlds, the more like unfathomable ‘black boxes’ they become – perhaps even to their creators. The more intimately they interact with nature – and with each other – the more ‘autonomy’ they have in creating unpredictable effects. Being ignorant of the future impact of one's innovations may, therefore, become the norm rather than the exception.” [4, p. 124] The remedy that the authors recommend is to expose scientists to cultural narratives that in a realistic manner are able to portray the risks and complexities involved in a responsible stance towards technological innovation: “Narratives teach continuity and comparison, and it is through developing such reflective skills about the cultural meaning of innovation that the virtue of responsibility can be developed.” [4, p. 139] Responsible research and innovation is here understood as a life-long process of cultivation, involving critical reflection of the kind that is typical of humanities subjects such as (art) history, aesthetics, comparative literature and philosophy.

To succeed in creating a multi-disciplinary ground for productive exchange between the sciences, humanities and arts it is of vital importance that neither of the cultures become complacent in their knowledge and world-view, but remain genuinely open to the other parts' perspectives. The humanist must be able to view technology (also) from the engineer's perspective in order to provide input that is considered relevant and thus acted upon. The gap between disparate world views must be bridged in order to provide a ground for genuine, meaningful and productive communication. A way to achieve this could be to expose the students to multidisciplinary team work applying the method of “critical making”.

2.2: Critical Making

The idea behind Matt Ratto's method of “critical making” is to cultivate a responsible relationship to technology and innovation. “Critical making” differs from the “critical design”-movement in that the focus and critical potential of the former is to be found in the process of designing, and not in the final, designed product. Ratto argues that in order to assume a nuanced view of technology, we must engage actively in its creation, and not only theorize about it. Engaging in the actual design of technology makes us aware of technology's qualities as objects that are “designed” and not merely given as “matters of fact”. He quotes sociologist Bruno Latour who addresses the distinction between treating technology as “matters of fact” and as “matters of concern”, where the latter requires personal investment and a “caring for” as opposed to merely “caring about” the effects of technology. Involving critical thinking and the active engagement with theoretical scholarship in the design process, “critical making” is ultimately “about turning the relationship between technology and society from a ‘matter of fact’ into a ‘matter of concern’” [5, p. 259].

This may in turn put an end to “the equating of criticality to destructive and innovation to constructive work that tends to be the norm within many (but by no means all) technical environments” [5, p. 259]. Admittedly, this technological prejudice is not an entirely uncommon gut reaction to the multi-disciplinary scope of RRI perspectives guiding our program, from scientists and engineers who have tended to eye critical thinking and reflection rather suspiciously as potential obstructions on the road

to technological innovation, instead of as valuable assets that could serve and even stimulate innovation.

3 PH.D. PROGRAM IN *TECHNOLOGY AND INNOVATION PROCESSES*

3.1: Program content and structure

An educational program in the third cycle (PhD level) needs to preserve the disciplinary integrity and a sufficient level of theoretical and analytical depth in its involved subjects. Therefore, we have divided the program into three main focus areas, titled Cultural Innovation, Digital Engineering, and Civil Engineering, which will secure the level of specialization within each student's subject area. The focus area of Cultural Innovation is built around the faculty's expertise within humanities subjects, design, applied art and drama. Digital Engineering includes expertise in ICT subjects, mathematical modelling, electronic engineering, and welfare technologies. The focus area Civil Engineering includes civil and mechanical engineering and building information modelling (BIM). Together, the three focus areas cover the entire span of subjects represented by the five departments that form our faculty. Several of the faculty's research groups have provided specialized courses within their area of expertise to be offered within each focus area, visualized in the model below as three "pillars of specialization" (Figure 1):

PhD-program in <i>Technology and Innovation Processes</i>			
	CULTURAL INNOVATION	DIGITAL ENGINEERING	CIVIL ENGINEERING
Elective specialisation courses (20 ECTS)	<ul style="list-style-type: none"> - Elective course (5 ECTS) - Elective course (5 ECTS) - Elective course (10 ECTS) 	<ul style="list-style-type: none"> - Elective course (5 ECTS) - Elective course (5 ECTS) - Elective course (10 ECTS) 	<ul style="list-style-type: none"> - Elective course (5 ECTS) - Elective course (5 ECTS) - Elective course (10 ECTS)
Compulsory program defining course (10 ECTS)	RESPONSIBLE RESEARCH AND INNOVATION METHODS (10 ECTS)		

Course part of 30 ECTS (+ thesis of 150 ECTS within one of the three pillars of specialisation)

Figure 1. Program structure

In addition to 20 ECTS of specialized courses within their focus area, all students are required to take the program defining compulsory course in *Responsible Research and Innovation Methods* (10 ECTS). This course defines the PhD program as a unified whole, and provides the students and researchers with a common ground for mutually beneficial cooperation. Dwelling on project organization through creativity and innovation, and applying perspectives from Responsible Research and Innovation (RRI), the course will prepare the students for planning, performing and leading innovative research and development work in contexts where multiple disciplines and concerns are involved. Connecting research and innovation to the anticipated futures in which they are going to play a part, a broad understanding of sustainability is sought, including ethical, social, cultural and environmental perspectives.

The course is organized in three modules: *Multi-disciplinary project team in research and innovation methods* (5 ECTS) is a practical module where the students work together in a multi-disciplinary project team, solving a given of self-defined task, with particular concerns to RRI and issues of sustainability. The module shall give the students insight in and practical experience with a variety of methods relevant for multi- and cross-disciplinary cooperation in research and development work. They shall also learn to identify and critically reflect upon the potential rewards and challenges of transgressing the boundaries of their specialized disciplines. *Responsible research and innovation* (2 ECTS) is planned to be organized as a lecture series or conference with international keynote speakers in the field of RRI. In the final module, *Conference participation* (3 ECTS) students are obliged to prepare a conference paper, present it and participate in the peer-review process of evaluating the

conference paper of a fellow student. As part of the PhD program, the Faculty of Technology, Art and Design will host a yearly conference where the two latter modules will be integrated.

In compliance with the main idea behind the program stating that cooperation across disciplines is an invaluable asset that must be practiced and taught to make us more apt to cope with the complexity of tasks and demands involved in tomorrow's world of technological innovation, this compulsory, program defining course will welcome students also from other PhD programs at the university college, for example, within health sciences and social sciences, to attend the course as one of their elective courses.

3.2: Recruitment of students

A definite advantage when combining a broad spectrum of disciplines in one PhD program is that it provides us with a wide and varied pool of students to recruit from, as the faculty has five internal master programs of approximately 200 students all together. For the program to be considered sustainable, it must be able to recruit a minimum of five students every year. This number should be well within reach, considering the massive interest we already now experience when presenting the program plan for students and colleagues at the university college and elsewhere. Currently, there are no other PhD programs in Norway with an explicit profile within RRI, and very few internationally.

4 CHALLENGES

Interdisciplinarity has been a buzzword in education and research for at least the past 20 years, in particular within the field of digital technology. Still, it is seldom truly realized, and the costs of crossing disciplinary boundaries may often be experienced as greater than the rewards. In terms of making an academic career, keeping to the traditional norms for research within one's area may be a safer route, to secure that both the relevance and the quality of one's research is properly recognized by peers. In certain cases, one does not need to depart far from one's primary discipline before quite different academic standards than the ones one is trained in prevail. For example, in "Design and the Construction of Publics", Carl DiSalvo discusses the "renewed interest in the intersection of technology, aesthetics, engineering, and politics" [6, p. 49] and argues that in the context of socially-engaged work there has been a "productive confusion between art and design in that it makes it easier to exchange forms, methods and effects." [6, p. 56] While Snow in his famous lecture specifically addressed the divide between the two cultures of science and the humanities, he was painfully aware that there are conflicting norms, interests and struggles also within each of these camps [1, p. 33]. This has been no less apparent in our work, where the fiercest territorial fights have often been fought between disciplines one would think were close enough to have similar interests – such as art and design.

We have also been challenged by the supposed opposition between basic and applied sciences, which is still considered to be a relevant parameter in relation to which one can position oneself as a researcher. In our group, we have on both sides of the cultural divide between science/engineering and humanities/arts/design a great number who define their research as applied, as well as a smaller number of researchers who are defending their right to do (and the general relevance of doing) basic research. We have discussed whether or not basic research should have a place in a program that is geared towards the practically applied (considering that most of our subjects are profession oriented.) One argument against the inclusion of basic research is that the program is already rather fragmented in scope, and that the certain "academic unity" that is required of a PhD program in Norway would demand that we limit ourselves to applied sciences and topics. However, as our defined scope of academic unity is precisely the demands to multi-disciplinarity and cross-disciplinary approaches that the grand challenges of tomorrow present us with, it can also be argued that we need to be able to combine basic and applied research, and look beyond the disciplinary and scientific prejudices of yesterday's scholars.

Finally, we must establish and actively work to internalize a culture of multi-disciplinary competence and exchange among our staff. This is vital to secure the multi-perspectival scope of the program defining course *Responsible Research and Innovation Methods*, and prevent the risk that one or a few disciplinary perspectives here become dominant, colonializing other disciplinary perspectives.

5 CONCLUSION

In an afterword to his 1959 lecture, published in 1964, Snow maintains his argument that in a time where science is granted the power to define so much of our lives and destinies, it is dangerous to have two cultures that cannot communicate, not least because the lack of understanding also serves to obscure communication between scientists and policy makers [7]. His hope for the future is that we can be able to reverse this trend through changes in the education systems, in which we give our students the overview and knowledge required to practice a combination of social awareness and responsibility with technological progression. A similar concern defines our motivation for entering into the contested territory of multi- and cross-disciplinary cooperation, and for keeping up our belief in the project, in spite of frequent reminders of how much easier it would have been to define and develop a program of less disciplinary complexity. Our goal is to educate students of solid disciplinary grounding who are able to communicate genuinely and productively across their disciplinary boundaries, to be informed by different perspectives and, occasionally, have the naturalized truths of their disciplines questioned and challenged. Likely, there can be no better answer to the challenges of tomorrow than to keep our educational programs flexible and prepared to adapt to changing circumstances in order to keep themselves relevant, as in the words of David H. Guston: “And while the urgency of today’s emerging technologies has our attention, there will surely be a new set tomorrow, and the day after tomorrow. Education and training is thus a critical endeavor for responsible innovation, and not only for the current crop of future workers.” [8, p. 117]

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