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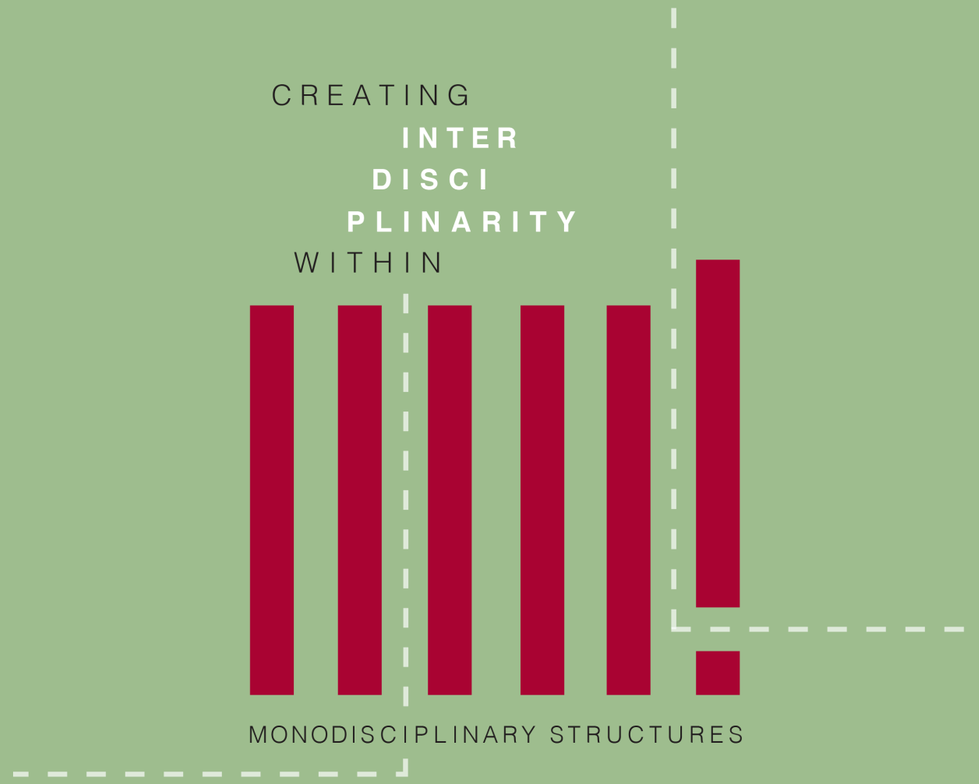
Creating Interdisciplinarity within Monodisciplinary Structures

UNIVERSITY OF COPENHAGEN
DEPARTMENT OF SCIENCE EDUCATION



PhD Thesis
Katrine Lindvig

Published 2018

Creating Interdisciplinarity within Monodisciplinary Structures

A THESIS PRESENTED
BY
KATRINE LINDVIG
TO
DEPARTMENT OF SCIENCE EDUCATION

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF
PHD – PHILOSOPHIAE DOCTOR
IN THE SUBJECT OF
UNIVERSITY SCIENCE EDUCATION

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THIS THESIS HAS BEEN SUBMITTED
TO THE PHD SCHOOL
OF
THE FACULTY OF SCIENCE,
UNIVERSITY OF COPENHAGEN

COPENHAGEN, DENMARK
SEPTEMBER 2017

Abstract

This PhD thesis is the result of a PhD project conducted as part of the development project 'Interdisciplinary education at UCPH'. Whereas the overall aim for the development project was to improve and support interdisciplinary teaching and learning at the University of Copenhagen (UCPH), the objectives of the PhD project were to explore the linkages between interdisciplinary research and education, and to follow the concrete development and execution of interdisciplinary educational activities. In order to meet these objectives, an extensive literature study and an ethnographic fieldwork were conducted.

In the literature study, a systematic search in nine online databases and subsequent analysis of the hits resulted in a review of 60 peer-reviewed international papers on interdisciplinary teaching practices. The fieldwork included observations and interviews across five interdisciplinary research projects in the Excellence Programme for Interdisciplinary Research at UCPH, following educational activities at bachelor's, Master's and PhD level. The empirical material was analysed and the findings described in four papers in the present thesis. The findings are as follows:

While interdisciplinary teaching is increasingly popular in higher education, very few empirical accounts have found their way to the peer-reviewed literature. The limited outlet of cases and empirical accounts affect the way, interdisciplinary teaching practices are perceived and practiced. Although 'grey' literature may offer more accounts of concrete examples of interdisciplinary teaching practices, the absence of these in the peer-reviewed literature limits the access to these experiences by scholars and teachers from other communities.

The fieldwork mapped a range of one-off interdisciplinary educational activities taking placed primarily as elective courses at the master's and PhD levels. In addition to these activities, there were also multiple unreported student-driven activities, linked to the research projects and taking place in the interstices of the monodisciplinary structures.

PhD students affiliated with the research projects were included in the study as they were also examples of interdisciplinary educational activities. Based on interviews with 25 PhD students the analysis addressed a multiplicity of expectations pointed towards the PhD students. The analysis highlighted students navigating expectations raised by the Principal Investigators of the interdisciplinary projects and by the monodisciplinary structures of the university, by limiting the scope for experimentation and

detours. The PhD students were thus at the same time seen as those enacting the interdisciplinarity of the projects and as students who were to be assessed within a monodisciplinary contexts.

Finally, an analysis of the official documents at programme level and of local interdisciplinary efforts at project level showed that the lack of definitions, of set criteria and of aims for the interdisciplinary activities in the programme had visible effects on the local practices of interdisciplinarity.

These findings point towards wide discrepancies in the use of the term interdisciplinarity, which have repercussions for the practices and incentives of creating interdisciplinary education, research and collaboration. Overall, the thesis show that interdisciplinary teaching and learning practices has to engage in a continuous balancing of different dynamics and interests. One important consequence of this is that the important interdisciplinary learning experiences of students occur in the interstices between monodisciplinary structures and practices and that a way of supporting the development of interdisciplinary competences among students would be to maintain the students' opportunities of acting within these interstices. Another finding of the research presented here is that although the discussion of how to understand and define interdisciplinarity is indeed important, insisting on particular fixed definitions may, at the end of the day, be detrimental to the interdisciplinary practices.

Abstract (dansk)

Ph.d.-projektet bag denne afhandling er en del af udviklingsprojektet ”Tværfaglige og tværfakultære uddannelser på KU”. Hvor udviklingsprojektet havde til formål at styrke tværfaglig uddannelse på Københavns Universitet (KU), var formålet med dette ph.d.-projekt i stedet at undersøge sammenhænge mellem tværfaglig forskning og skabelsen af tværfaglige uddannelsesaktiviteter, og endvidere at følge den konkrete udvikling og gennemførelse af tværfaglige uddannelsesaktiviteter. Som et led i denne undersøgelse blev et omfattende litteraturstudie og et længerevarende feltarbejde gennemført.

Litteraturstudiet blev gennemført som en systematisk søgning i ni onlinedatabaser med en efterfølgende læsning og analyse af 60 fagfællebedømte, engelsksprogede artikler omhandlende tværfaglige undervisningspraksisser. Feltarbejdet omfattede observationer og interviews med forskere, undervisere og studerende på bachelor-, kandidat- og ph.d.-niveau, på tværs af fem udvalgte forskningsprojekter i KU’s stjerneprogram for interdisciplinær forskning. Det producerede empiriske materiale blev analyseret og derefter præsenteret i fire artikler, som udgør den største del af nærværende afhandling. De væsentligste resultater af disse analyser er følgende:

På trods af den stigende interesse for tværfaglig undervisning inden for de videregående uddannelser har det kun ført til en begrænset mængde case-beskrivelser og konkrete eksempler i den internationale, fagfællebedømte litteratur. Dette begrænsede udvalg sætter sig spor i måden, hvorpå tværfaglige undervisningspraksisser bliver genkendt og praktiseret. Selvom den ’grå’ litteratur bidrager med op til flere casebeskrivelser og eksempler fra praksis, resulterer placeringen uden for den fagfællebedømte litteratur i en begrænset vidensdeling på tværs af forskningsmiljøer.

Feltarbejdet kortlagde en række enkeltstående tværfaglige uddannelsesaktiviteter, der primært blev udbudt som tilvalgskurser på kandidat- og ph.d.-niveau. Foruden disse aktiviteter belyste feltarbejdet dog også adskillige studenterdrevne aktiviteter, som lå i forbindelse med de tværfaglige forskningsprojekter, i rummene mellem de enkeltfaglige strukturer og uddannelser. Disse aktiviteter blev ikke omtalt i de officielle evalueringer fra projekterne.

De mange ph.d.-studerende tilknyttet forskningsprojekterne blev også fulgt som en del af feltarbejdet, idet de også repræsenterede tværfaglige uddannelsesaktiviteter. Analysen af interviews med 25 af disse studerende

viste, hvordan de ph.d.-studerende navigerer ud fra forventninger rejst af projektlederne fra de tværfaglige forskningsprojekter og ud fra de enkeltfaglige universitetsstrukturer. De ph.d.-studerende blev dermed både forventet at skulle repræsentere tværfagligheden i forskningsprojekterne og at skulle bedømmes ud fra retningslinjer udviklet inden for enkeltfaglige kontekster.

Endelig viste analysen af officielle dokumenter fra ledelsen i stjerneprogrammet, kombineret med analysen ad lokale tværfaglige initiativer, at uklare udmeldinger og manglende evalueringskriterier fra programledelsens side havde udtalt effekt på de lokale tværfaglige uddannelses- og forskningspraksisser.

Disse resultater peger på tydelige forskelle i brugen og forståelsen af begrebet tværfaglighed, hvilket har konsekvenser for praksisser og incitamenter til at skabe tværfaglig uddannelse, forskning og samarbejde. Overordnet set viser afhandlingen, at tværfaglige undervisning- og læringspraksisser er nødt til at forholde sig til en kontinuerlig afvejning af forskellige dynamikker og interesser. En pointe er her, at vigtig tværfaglig læring og erfaring opnås i rummene mellem enkeltfaglige strukturer og praksisser, og at en måde at støtte udviklingen af de studerendes tværfaglige kompetencer på ville være at fastholde og bevare de studerendes handlemuligheder inden for disse mellemrum. Et andet resultat af den præsenterede forskning er, at der på trods af vigtigheden i at diskutere de mange forskellige definitioner og forståelser af tværfaglighed, ligger en risiko i at insistere på for fastlåste definitioner, da de i sidste ende kan modarbejde tværfaglige initiativer.

Introduction

The meaning of the title ‘Creating interdisciplinarity within monodisciplinary structures’ is twofold: First, the thesis is based on the findings from an ethnographic fieldwork, following five interdisciplinary research projects as they created educational activities connected to their research in the Excellence Programme for Interdisciplinary Research, situated within the monodisciplinary structures at the University of Copenhagen (UCPH). The title, secondly, also refers to my PhD study at UCPH, where I have conducted my fieldwork in research projects across the university, while funded by two different faculties and immersed in a development project with the aim of strengthening interdisciplinary education at UCPH.

The description, design and execution of this setup have been equally difficult and rewarding. It has been difficult because my position was always contested as a ‘matter out of place’: I was conducting *research* as part of a *development* project and I was studying the creation of *educationa*l activities within *research* projects. The setup has, however, also been tremendously rewarding as I have had the chance to access a research field from an unusual angle and to explore issues of interdisciplinarity which have previously been divided between several disciplines.

The thesis is based on a PhD project encompassing research in addition to development work at UCPH. The thesis is thereby the final outcome of my PhD project as well as a deliverable from the development project ‘Interdisciplinary Education at UCPH’.

Navigating the thesis

The thesis consists of four parts:

1. The first part describes the background and context of the PhD project.
   A part of this is a clarification of the linkages between the *Excellence Programme for Interdisciplinary Research*, the development project *Interdisciplinary education at UCPH* and my PhD project. Following this, I address how I have navigated the literature and the definitions of the term interdisciplinarity.

2. In the second part, I argue for my methodological choices and describe the various methods applied in producing the empirical material and the subsequent analyses. I end this part with a discussion of my positioning in the field and of the validity and rigor of a study such as this.

3. The third part consists of the four papers of which one has been published, two are under review and one has been submitted to international peer reviewed journals

4. Part four is the concluding discussion, where I answer my initial research questions and discuss the further findings of the study.

Contents

Listing of figures and tables in the thesis

Acknowledgements

First of all, I would like to thank Jens and Maja for pushing through and securing my position as a PhD student in the development project. Thank you, Lars, for agreeing to become my supervisor and for handling all issues, big as small, serious as ridiculous, project related and personal with equal portions of regal calm and RUC pragmatism. I doubt I would have made it this far without you.

During my PhD project, I have been fortunate to be a part of an amazing workplace, with a great location and even greater people. My colleagues at the Department of Science Education have all helped in making this PhD project possible and enjoyable. A special thanks to my fellow PhD students, my PhD office and its changing inhabitants: you are an institution worth keeping.

A group of people have contributed to the more creative sides of my PhD project. Thank you, Sarah, for making me a less procrastinating writer and for carrying me through to the end. Thank you Jesper for running with my ideas and for technical assistance in sorting out the many post it's and putting them into networks. Thank you, Nana, for drawing my thoughts and fixing my front pages. Thank you, Trine and Ulla, for your support, inputs and for co-brainstorming on various postmodern theoretical detours. Thank you, Line and David, for being partners in creative and collaborative crime.

Thank you, Cathie, for being my bystander all the way through the project, for offering me desk space at your department, even before I was a PhD student; for hosting our visits in Edinburgh and for reading all my papers even in the very early and poor states. Thank you for your professional and personal support and thank you for introducing me to Laura. You two make any trip worthwhile.

A special thanks to my friends and family for support and cheer and for patiently listening to my endless elevator pitches and acting as if my continuous talking is comprehensible. One day it will hopefully all make sense.

Thank you, Bjørn and Elva, for keeping me grounded, happy and relatively sane, and for reminding me of the important stuff in life (e.g. Friday candy and Ninja swords).

Finally: thank you, Niels, for coping with me. I owe you. I know.

Papers included in the thesis

- Paper I:
  Different, difficult and local: A review of interdisciplinary teaching practices
  Katrine Lindvig & Lars Ulriksen
  Review of Higher Education
  Accepted for resubmission with major revisions

- Paper II:
  Creating interdisciplinary education within monodisciplinary structures: the art of managing interstitiality
  Katrine Lindvig, Catherine Lyall & Laura R. Meagher
  Studies in Higher Education
  Published online: 21 August 2017

- Paper III:
  'It's really very schizophrenic': Interdisciplinarity and the Implied PhD Student
  Katrine Lindvig
  Journal of Higher Education Research & Development
  Under review

- Paper IV:
  Strategically unclear: Exploring an Excellence Programme of Interdisciplinary Research
  Katrine Lindvig & Line Hillersdal
  Social Studies of Science
  Submitted

1

BACKGROUND & LITERATURE

Background

The summer of 2012 was busy at the University of Copenhagen. June 20th, a call for applications for the Excellence Programme for Interdisciplinary Research was made, and the researchers at UCPH were given two months to write a preliminary application to join the programme. The projects were to span the faculties and departments and address interdisciplinary topics. The call had a double focus on strengthening internal collaboration across the university, while positioning the university for the European Research programme Horizon2020, by addressing societal challenges through interdisciplinary research. Of the 37 projects that were sent on from the second round of applications, 18 projects were awarded a total of 64 million Euros, which were to be spent over a course of 3-5 years.

While the research groups at UCPH were preparing their applications, I was working as a research assistant on 'Crisscrossing UCPH', a project on interdisciplinary research and collaboration at UCPH. My job was to map experiences of working across disciplines at UCPH and thereby highlight (best) practices of interdisciplinarity at a research intensive, faculty-based and monodisciplinary university.

A year later, the 18 projects had slowly kicked off and a new round of funding was prepared for development projects strengthening cross-cutting educational initiatives at UCPH. For these development projects, six million Euros were set aside and an equally swift application round began. Whereas the awarded projects in the Excellence Programme had been singled out from a total of 37 project applications, in this case, the 20 projects were instead all pooled together in fewer projects, under larger themes. Thus, within six months, 20 project applications turned into six development projects, each focusing on a cross-cutting educational initiative at UCPH e.g. 'Research based education', 'Summer schools', 'Online and blended learning', 'Innovation' etc. A project on interdisciplinary education at UCPH was among these six projects. My PhD project became part of this project (see figure 1).

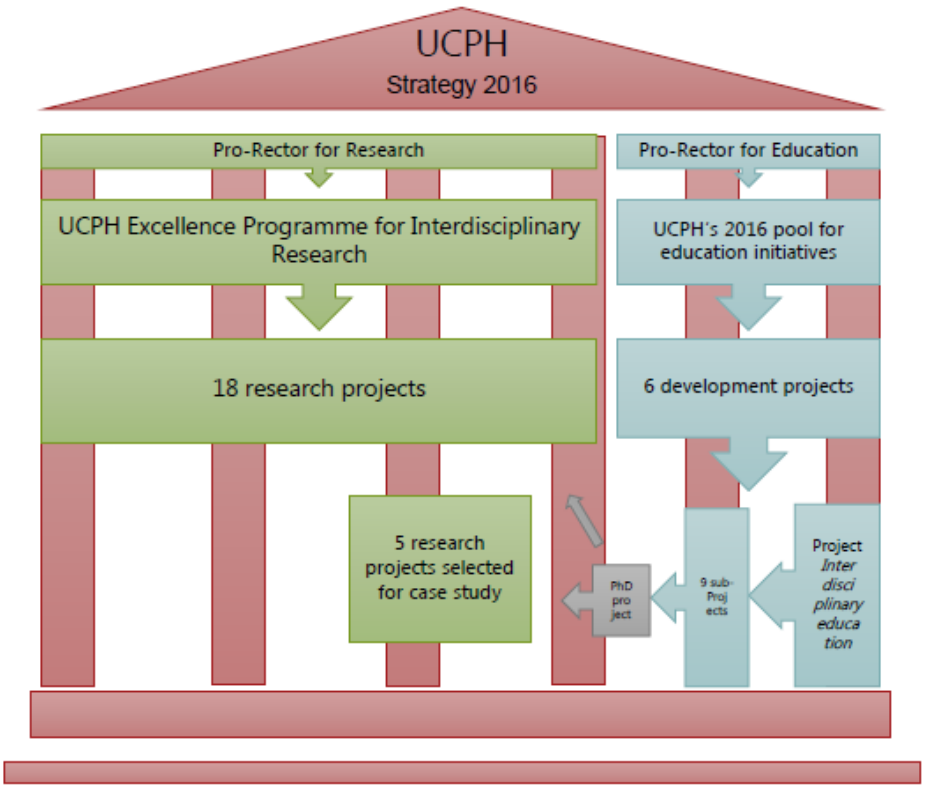


Figure 1. Research and development projects under *Strategy 2016*

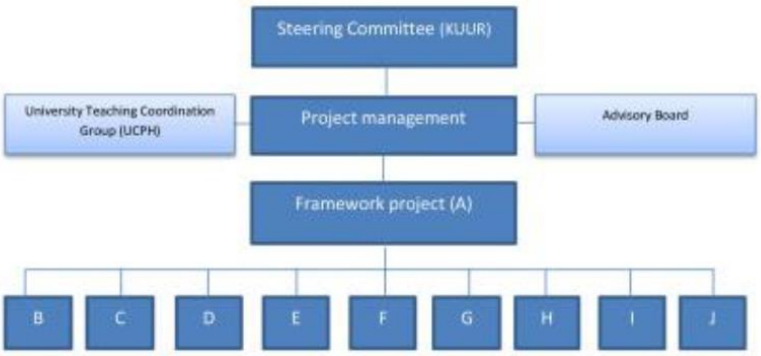
The development project 'Interdisciplinary education at UCPH'

According to the university management, the six development projects were not intended to 'conduct research'; they were 'development projects with the purpose of strengthening and supporting activities already taking place at the university'. While the 18 research projects in the Excellence Programme were anchored in the Research and Innovation section and led by the pro-rector for Research, the six development projects were anchored in the three educational units at UCPH and managed by the educational section (KUUR), led by the pro-rector for Education. I was thus not really supposed to become a PhD in the project 'Interdisciplinary Education at UCPH'. But I did. My position as PhD student in the project 'Interdisciplinary Education at UCPH' was secured by funding from the Department of Media, Cognition and Communication at the Faculty of Humanities and from the Department of Science Education, at the Faculty of Science.

As a result of the pooling of projects, Interdisciplinary Education at UCPH ended up consisting of a Framework project and nine subprojects (see

figure 2 below), each focusing on an aspect of interdisciplinary education at UCPH. As a PhD student I was also part of the Framework project, where I spent a large part of my mandatory 840 working hours (see paper III for a description of the Danish PhD-programme structure).

Figure 2. Structure of project *Interdisciplinary education at UCPH*



To give an impression of the various aspects of interdisciplinary education the subprojects covered, the nine sub project titles are listed here:

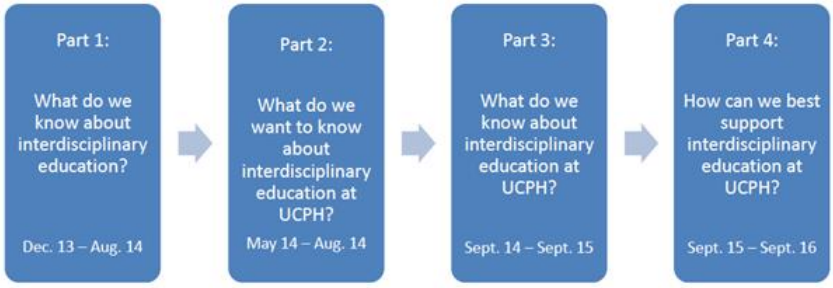
a) Framework project
b) Organizational Challenges for Interdisciplinary Education at UCPH
c) Gender Certificate - a new education initiative across faculties at UCPH
d) Interdisciplinary IT-education
e) Didactical Challenges in an Interdisciplinary Master's Program
f) Science Communication - an important tool for interdisciplinarity
g) Development of Concepts for Interdisciplinary Courses at the Faculty of Law
h) Progression in Interdisciplinary Education
i) Interdisciplinary Education and High-End Research
j) A Student-Perspective at Interdisciplinary Education

Apart from the Framework project, it was only project (J) and my project (I), which was managed and run from the department of Science Education. The remaining projects were placed at other departments across the university and thus the whole project only gathered once or twice a year.

In the project set up, the Framework Project (A) were to gather knowledge and experiences from the remaining projects and merge them into joint products. Because the project consisted of so many and such varied projects, it was crucial to create consensus around a set of joint objectives and milestones that would be defined enough to set a direction, yet flexible

enough to include all the projects. As a way to achieve this, a process consisting of four parts (depicted below) was planned:

Figure 3. Process plan for Framework-project in project *Interdisciplinary education at UCPH*



As a way to ease the collecting process, Part 1 (see figure 3) was intended 'to contribute to a clarification of key concepts on interdisciplinarity across UCPH' and 'to identify main components in theory of knowledge in interdisciplinarity that can be used to plan and conduct interdisciplinary teaching and education'. The Framework project thus planned a literature study on interdisciplinary teaching practices (conducted by me) and a literature study of an interdisciplinary philosophy of science. While these two literature studies were to create a knowledge base for the entire project, providing firm definitions of interdisciplinary teaching practices and ontological questions of interdisciplinarity in the shape of short tool-kit papers (I will get back to this in the next chapter), they were also to inform a template of questions for Part 2 of the process.

In Part 3 the subprojects were to harvest the findings from their activities and to fill out the template created in part 2. This was also where my fieldwork took off (see timeline in methodology chapter) and where it became quite apparent just how diverse the subprojects were. Whereas one project was running an interdisciplinary communications course, another project was setting up an IT-certificate to be offered across the university, and yet another project was mapping the administrative barriers for interdisciplinary activities at UCPH. Hence, it proved quite difficult for the projects to adhere to the same template. Nonetheless, this was the intention inasmuch as the fourth and final part of the process was 'to develop cross curricular pedagogies, which can be used to plan and conduct interdisciplinary teaching and education', and furthermore 'to develop didactic tools, courses and consultancy services to support

educators, course managers and heads of studies as they are to plan and conduct interdisciplinary teaching and education'.

Part 4 was where the project 'Interdisciplinary Education at UCPH' had to prove itself as a development project that could in fact create concrete support mechanisms for future use at UCPH. With all the projects having such different aims and set-ups, the idea of developing cross curricular pedagogies and didactic tools that could travel across various disciplines, levels and activities was de facto adjusted. In the fall of 2016 the Framework project gathered and looked at the materials at hand. Around half of the projects had delivered findings which could be further used in creating recommendations for future interdisciplinary educational activities at UCPH. Furthermore, an additional researcher and a consultant were included in the Framework Project to help developing tool-kit papers and peer reviewed journal papers that were to be part of the deliverables. The results of part 4 and of the development project were thus a range of publications, a list of recommendations for improving and supporting interdisciplinary education at UCPH, as well as a website with recommended literature, activities and tools for supporting the development of interdisciplinary educational activities. A set of key findings on interdisciplinary education at UCPH was prepared for the university management and were in summer 2017 put forward as recommendations in preparing the university strategy 2023 (see appendix 2).

The PhD project

As a PhD student in the development project, I was assigned with two different responsibilities. One was to participate in the Framework project and thereby contributing to aims and deliverables put forward in the process plan (figure 3). Another was to conduct my PhD study as the subproject (i) in figure 2. Below, I will explain these two parts of the PhD project.

The Framework project

One of the aims of the Framework project was to pin down the concept of *interdisciplinarity* and of getting to grips with the many definitions and taxonomies of the term. Furthermore I was to add to the development of 'didactic tools, courses and consultancy services to support educators, course managers and heads of studies in their planning and conduct of interdisciplinary teaching and education at UCPH' (Project web-page, 2014).

As part of the Framework project, I therefore conducted the literature study used for the knowledge template; I wrote a tool-kit paper and published a Danish peer-reviewed paper (Lindvig & Ulriksen, 2016), both together with my supervisor. Furthermore, I facilitated various workshops and gave lectures on interdisciplinarity. As a result of a former collaboration with the Danish think-tank Braintrust and an inquiry to teach on one of the summer schools I had conducted fieldwork on, I teamed up with David Earle, Art Director in Braintrust and Line Hillersdal, anthropologist and post.doc at UCPH. Together we developed a tool for enhancing interdisciplinary collaboration. Upon the application of the tool in the summer school, the tool took on a new life and turned into CoNavigator, a tool which is currently also being used at the University of Maryland, Baltimore County, US. The process and results of this tool are described in the newsletter article enclosed in the appendix (Hillersdal, Lindvig & Earle, 2017).

The PhD study

The aim of the development project (to strengthen interdisciplinary education at UCPH) was a logical continuation of the work I had previously done at UCPH, which was mapping interdisciplinary research and educational practices. Another motivation was the Excellence Programme for Interdisciplinary research. Not only did the research projects in the Programme run simultaneously with the development project, they were also explicitly required to create educational elements based on their research. This altogether represented a unique opportunity to study interdisciplinary education linked to research and in the making. Thus, in addition to my role in the development project, the overarching aim of the PhD project was to explore the linkages between interdisciplinary research and interdisciplinary education, based on ethnographic fieldwork, using five research projects in the Excellence Programme as cases. The research questions were as follows:

Research questions:

- How do researchers from different academic disciplines partake in the creation of interdisciplinary educational elements
- What is the relation between the intention behind the educational elements and the final results?
- What are the roles of the faculty and students in the collaboration, planning and execution of the activities?

In exploring the processes of creating interdisciplinary education, I ontologically took my inspiration from research and theory positioned within postmodern, constructivist and interactionist paradigms of thought (Blumer, 1969; Denzin & Lincoln, 2005; MacLure, 2003; Willis, 2000a). This inspiration has affected the research questions, the research design as well as the outcome.

The research questions are explorative and motivated by a lack of focus on the process and development of interdisciplinary education and studies (Stronach & MacLure, 1997, p. 88). A lot of attention has been paid to the policy level and strategies behind the educations, as well as on the assessment and evaluation of the latter (Andersen & Jacobsen, 2012; Augsburg & Henry, 2009; Boix Mansilla, 2006; Klein, 2010; Veronica Boix, Elizabeth Dawes, Christopher, & Carolyn, 2009). But the long and often surprising or even frustrating processes are rarely touched upon. As MacLure writes, educational reforms and policies are designed to hide ambiguities, create clarity, uniformity and transparency: 'what such policies conceal are the pain, conflict, failure, chance, irrationality and non-countable events that are also, unavoidably, implicated in teaching and learning' (MacLure, 2006a, p. 3). In her critique, MacLure describes these events and ambiguities as the postmodern; the things that are left outside of the modernist projects of teaching and learning (ibid). In approaching postmodernism as a strand occurring simultaneously with the modern (and not post), she draws on Lyotard and his work 'the postmodern condition' (1984). Here, he defines postmodernism in the double meaning of the word condition; as a mode of being and as a prerequisite. Postmodernism thus arises after the modern project, as a counter-reaction to the normative of linear and stable progress. Meanwhile, postmodernism is also conditioned by the modern, as a contemporary critique of the modern project. On a more concrete level, the problem with cleaning and tidying up is that it conceals processes and elements that are equally as important to a successful outcome, as clear and unambiguous descriptions may seem. Conflicts, mistakes, dead ends and unexpected turns are just as much a part of the development processes as the policies and ideas that went before. Thus; the inspiration deriving from a postmodern approach is to focus just as much on the processes and events that do not have a checked box or a place for descriptions in the premade forms and surveys (Lather, 2006; Law, 2004; Merton, 1968).

Along with the research questions, the research design is also marked by a postmodern approach. While postmodernism might be seen as a counter or a critique of the modernist project of progress (Lyotard, 1984), it does not

necessarily imply an emphasis on problems or conflicts. On the contrary, the reason for conducting an explorative and ethnographic fieldwork in this study has exactly been to shift the focus from a heavy emphasis on problems, barriers and a corresponding selection of answers and solutions towards more complex (and hopefully less normative) understandings of education (MacLure, 2003, 2005). The former emphasis on problems and immediate application of solutions is partly due to the fact that University education and teaching is a relatively new field of research, at least in a Danish context (Carney, 2009; Skovgaard-Petersen, 1997). Many studies so far have been motivated and pushed forward by urgent problems such as a dropout rates (e.g. Boeskov & fl., 2003; Holmegaard, Madsen, & Ulriksen, 2016), lack of quality in supervision and implementation of new rules and university laws (Sarauw, 2011; Wright, 2010) etc. There is nothing wrong with this applied and problem oriented focus as long as it is not left alone as the only type of research within this field. The focus on solving the concrete and occurring problems is ensuring a long list of efficient solutions and thereby ensuring a high quality in education.

However, one also has to be aware that such a problem orientation is a framing mechanism that creates a certain worldview and thereby also dictates certain solution models (Bacchi, 2009). If this is not combined with a more open ended and explorative research approach, we risk losing what research in other fields are praised for; challenging and redefining the basic assumptions and significant correlations in a given field (Jensen & Bengtsen, 2011). In a postmodern and interactionist perspective, the imperative is on the meaning making and negotiations taking place at local levels (Willis, 2000b). It is a call for research that add details, perspectives and messiness to a field of otherwise firm and clear conclusions (Baudrillard, 1988, p. 100).

Finally; the inspiration from the postmodern and interactionist literature is visible in my analytical approach, which could be termed as ‘bricolage’ (Denzin & Lincoln, 2005, p. 4; Kincheloe, 2001). In tackling the field and the empirical material, I draw on a range of different literature and theory, situated within various paradigms and disciplines. I consider theory, metaphors, images and literature in general to be tools to think with, tools for approaching and for challenging the empirical material. In doing so, I am motivated by MacLures search for the ‘frivolous’ (MacLure, 2006b) and by Willis’ ambition to tell ‘‘my story’ about ‘their story’ through the fullest conceptual bringing out of ‘their story’’ (Willis, 2000b).

Conditions and context of the PhD project

As will be stated many times throughout this thesis, the Excellence Programme for Interdisciplinary Research is distinctive (see paper IV for a thorough argumentation). The amount of money awarded to research projects situated within one institution, the selection process, in addition to the requirement of creating educational activities related to the research, make the Programme different from other national and subnational programmes. The planning and execution of the six development projects also made for a particular setup; especially the emphasis on development as opposite to research and the lack of evaluation guidelines or strategies of subsequent implementation made it difficult to navigate for the project leaders of the six projects as well as for the faculty involved.

Being situated as a PhD student in a subproject and the Framework project within the development project, while conducting fieldwork in research projects across the Excellence Programme, has provided me with many different hats: one of my informants thought I was sent out to spy for the university management; others took me as a consultant that had to approve of their activities. During the last year of my PhD project, I experienced being referred to as a process evaluator connected to the Excellence Programme and at the annual gathering for the Principal Investigators (PIs) for the 18 research projects, I was once pointed to as the official link between the research projects and the development projects. Wearing many hats and being assigned even more has affected my PhD project. The influence from the development project is visible in the more instrumental and mapping approach applied to the Danish article and the tool-kit paper; in experiences during my field marked by the certain positions I have been assigned by my informants, and finally in developing the tool CoNavigator.

Additionally, there is the balancing act of conducting research within one's own field. In this case, I was an insider as a researcher at the university where I conducted my fieldwork and as a PhD student in an interdisciplinary project, working with interdisciplinarity, while interviewing PhD students involved in interdisciplinary research projects. As I will discuss more detailed in part 2 of the thesis, there are of course issues at stake when conducting research as an insider (Adriansen & Madsen, 2009). While my insider position blessed me with a certain access to the field, I was also aware of the risk of conducting fieldwork in a current and possible future workplace. For this reason also, I chose to anonymise the cases and informants as much as possible in the thesis, as I would fear that

had the personal details not been removed, my critical approach to the empirical data might.

Having given some background on the setting and context of the PhD project, I will now move on to the literature and definitions of interdisciplinarity applied throughout the PhD project.

Navigating the literature and definitions of interdisciplinarity

As Newell (2007, p. 92) has stated, the term 'literature review' can be misleading in that an interdisciplinary research project typically requires several separate literature reviews, one on each of the topics comprising a different facet of the complex topic under study. While the emphasis on *interdisciplinary educational elements* with the Excellence Programme at UCPH as case has encircled the body of literature, it is extensive. The first paper is based on a literature study and is a review of empirically based, international peer-reviewed papers on interdisciplinary teaching practices in higher education. The three remaining papers each address an aspect of creating interdisciplinary educational activities within a monodisciplinary institution. Included in each of these three papers are reviews of the areas of literature, in which the papers are situated. These areas encompass interdisciplinary educational activities within traditional higher education structures; doctoral students involved in interdisciplinary research; and local outcomes of strategic funding of interdisciplinarity. As the literature reviews are thus to be found in the four papers, the following will instead focus on how I have approached and navigated the vast field of literature on interdisciplinary education, collaboration and research.

Defining interdisciplinarity

In a tale from the Norse Mythology, the warrior god Thor is challenged to lift Loki's little cat and then later realises that what he was actually lifting was the Midgard Serpent that surrounds the entire world. This tale strikes a particular chord with me when thinking of the term interdisciplinarity.

As stated in the previous chapter, an aim of the development project was to contribute to a clarification of key concepts of interdisciplinarity related to education, in English and in Danish language. The plan was to create a two page tool-kit paper that in a few words would define the term interdisciplinarity, the various types and degrees of interdisciplinarity and finally how to translate the terms in to a Danish educational context. In retrospect, this was a very ambitious plan.

A starting point for understanding the term (or at least the development of the term) interdisciplinarity is the extensive works of Julie Klein (Klein, 1990, 1996, 2005 to name a few). In her work, Klein links back to the OECD conference in 1972 focusing on the "problems of interdisciplinarity in teaching and research in Universities" (Apostel, 1972). Klein's general definition is that

> Interdisciplinarity is a means of solving problems and answering questions that cannot be satisfactorily addressed using single methods or approaches (Klein, 1990, p. 196)

This definition is inspired by Jantsch's (1972) original division of the concept into multi-, pluri-, cross-, inter- and transdisciplinarity defining degrees and types of integration between disciplines. A range of North American scholars, many of them involved in the community around the Association for Interdisciplinary Studies, have contributed to the literature in refining the definitions and descriptions in relation to interdisciplinary education (Augsburg & Henry, 2009; Davis, 1995; Haynes, 2002; Klein, 2010; Newell, 1994; Nikitina, 2005; Repko & Szostak, 2017). Among this group, the following definition is widely used:

> A process of answering a question, solving a problem, or addressing a topic that is too broad or complex to be dealt with adequately by a single discipline or profession… [Interdisciplinary Studies] draws on disciplinary perspectives and integrates their insights through construction of a more comprehensive perspective. (Klein & Newell, 1997)

Even though the Northern American contribution to the literature on interdisciplinary research and teaching is extensive - possibly because of the liberal arts tradition that differs from the stronger framed European tradition (Bernstein, 2000) - it only covers part of the field of scholars working with definitions of interdisciplinarity: Huutoniemi (2010) and Aboelela (2007) have written extensive reviews and overviews of current definitions and literature; in 2010, the Oxford Handbook of interdisciplinarity was launched to consolidate the concept, and several others have taken up the task to define what interdisciplinarity really is (Frodeman, Klein, & Mitcham, 2010; Graff, 2015; Jacobs, 2014; Lattuca, 2001; Moran, 2010; Weingart & Stehr, 2000 to name a few). Similar to Klein and Newell, the latter scholars do also lean on the definitions put forward in (1972). However, according to Repko (2007) the developed definitions and views of interdisciplinarity fall in two distinct categories: the 'generalist' and the 'integrationist' view. The generalists are the ones that define interdisciplinarity loosely to mean '"any form of dialogue or interaction between two or more disciplines" ' (Repko, 2007 quoting Moran, 2010, p. 14). The integrationists, on the other hand, 'stress the priority of integration and are concerned with developing a distinctively interdisciplinary theory-based research process and describing how it operates' (Repko, 2007, p. 2). Examples of integrationist are among others Klein and Newell (1997) and Nikitina (2005).

Reading across this widely cited literature on interdisciplinarity, one thing has become very clear: the attempt to find a definition that sufficiently covers the various practices and examples of research and education crossing traditional institutional boundaries is stillborn. For every paper and researcher defining interdisciplinarity, details are added or subtracted and distinctions are made. The definitions equally reflect the national, educational, research and funding structures in which they are created, and translations of the terms into subtypes and even other languages add to the ambiguity of the term. This does not make a review redundant; on the contrary, it means that attention must be paid to the very local situations and contexts the specific definitions depart from.

Whereas many reasons are given for an integrationist approach to interdisciplinarity - among others that integration is achievable and provides a more comprehensive understanding of otherwise conflicting insights (Repko & Szostak, 2017, p. 220) - they do, however, not reflect or consider the various contexts and uses of the definitions. In his book, Moran applies a very loose definition as he contends that the value of the term lies in the indeterminacy and flexibility which enables him to explore multiple examples of disciplines connecting, crossing or integrating (Moran, 2010, pp. 14–16).

> Within the broadest possible sense of the term, I take interdisciplinarity to mean any form of dialogue or interaction between two or more disciplines: the level, type, purpose and effect of this interaction remain to be examined. (Moran, 2010, p. 14)

Lattuca is also mentioned as a generalist as she focuses more on the questions asked than on integration (Repko, 2007, p. 2). Meanwhile, Lattuca's purpose is another than that of Repko and Szostak as she sets out to understand the meaningful connections between teaching and research and for that sacrifices some of the clarity that a more firm and unified definition of interdisciplinarity would provide (Lattuca, 2001, pp. 19–20)

I stress these differences and discussions as they are important in understanding how I, in the PhD project, have applied and navigated by the definitions of interdisciplinarity. For the before mentioned tool-kit paper and for a Danish paper I wrote together with my supervisor (Lindvig & Ulriksen, 2016), the table below was created. The table compares definitions, originally put forward by Jantsch (1972) to a Danish translation by Ulriksen (2008) and to Kleins three overall definitions (1990). Finally a short numerical interpretation is added. In the Danish paper, an interdisciplinary course was applied as case for discussing the various

factors influencing intended and realised types of interdisciplinarity and degrees of integration between disciplines. In addition to the table, three figures were applied (see also paper I), depicting different types and levels of integration between disciplinary elements in educational courses and programmes.

Table 1: Overview of definitions (Lindvig & Ulriksen, 2016)

Level	Jantsch	Ulriksen (in Danish)	Klein	In short
1	Multidisciplinarity	Mangefaglighed	Multidisciplinarity	1+1=2
2	Pluridisciplinarity	Flerfaglighed		
3	Crossdisciplinarity	Støttefaglighed		
4	Interdisciplinarity	Mellemfaglighed	Interdisciplinarity	1+1=3
5	Transdisciplinarity	Overskridende faglighed	Transdisciplinarity	1+1=1

Thus, in the first phases of the PhD and of the development project, the work primarily consisted of getting to grips with the discussions and definitions of interdisciplinarity in the wide-ranging body of literature. The idea was to explore existing interdisciplinary programmes and courses at UCPH and then, through a larger literature review (paper 1), to get an overview of the field of interdisciplinary teaching practices. In writing the papers for the Framework project and in various presentations and workshops related to the development project, literature placed in the 'integrationist' category proved to be useful. There was something fulfilling in the ability to 'diagnose' a course as for instance multidisciplinary or crossdisciplinary, and it was interesting to see how the integrating aspects would change from activity to activity and how it often ended up becoming the responsibility of the students (Lindvig & Ulriksen, 2016). In these processes, the taxonomies and definitions of interdisciplinarity became tools for analysis and thus gave a direction for the work. This, however, changed.

When my fieldwork in the five case projects began (see table 2), the definitions and taxonomies appeared increasingly redundant. Most informants did not know of (and much less navigate from) differences and variations of interdisciplinarity and the more interviews and observations I conducted, the more important it became to understand how they navigated from more strategic notions of interdisciplinarity. Hence, working with a loose and more flexible definition of interdisciplinarity made it possible to approach the field with a wider lens and with an attention to the

articulations of interdisciplinarity made by the informants. Thus, for all the reasons Moran's (2010) definition of interdisciplinarity is placed in the generalist category by Repko (2007) (e.g. loose, pragmatic), it was applied as a working definition in my field work.

This shift from the literature defined by integration and towards the more pragmatic definitions also became apparent in writing the review of interdisciplinary teaching practices (Paper I). From January to April 2014, I conducted the literature study, starting with the help from a team at Aarhus University Library. I then read the articles, analysed the findings and presented it to the Framework project. Then I went on Maternity leave for seven months. As I returned to work, my field work picked up speed. While the initial intention behind writing the review was to thoroughly map the plethora of interdisciplinary teaching practices and thus provide a schematic overview, at this point it seemed equally important to take the naming and positioning of the term interdisciplinarity into consideration. As we also unfold in paper I, many of the articles did not describe practices that were particular to interdisciplinarity, nor did they navigate by taxonomies and overviews of disciplinary integration. Thus, ambivalence in the use of the integrationist perspectives arose.

In the remaining papers (II, III, IV), I have turned towards areas of the literature that were carried by empirical cases and where interdisciplinarity were used as a wide concept , as opposed to more narrow definitions of interdisciplinarity. Meanwhile, to conclude on this section: The definitions of interdisciplinarity are multiple. Throughout my PhD project I have made a shift from a strong focus on the integrationist definitions of interdisciplinarity, towards the more loose and flexible definitions. This is, however, not a testament of one category of definitions working better than the other. It is a sign of the differences in working with interdisciplinarity for mapping and teaching purposes and as an entry point to understanding dynamics at play in the development of research and educational activities, spanning across disciplines, research fields and physical space. These differences, I believe, have become particularly visible in my PhD project, as I have navigated between development work and research.

In the following chapter I will describe the methodological considerations, including the methods and analytical framework applied.

2

METHODOLOGY

Methodology

The PhD project consists of three parts: a literature study, a multi-sited ethnographic fieldwork and finally the development of various materials that are part of the Framework project deliverables. In this chapter, I will thus elaborate on the methodological considerations behind the research design, the methods applied in the fieldwork as well as the analytical framework used for approaching the empirical material.

The fieldwork

As stated earlier, the aim of the PhD project has been to explore how researchers from different fields partake in the creation of interdisciplinary educational activities; and to explore the relations between the intended and realised activities. Furthermore, the study has been a way to understand the roles of students and faculty in planning and collaborating around interdisciplinary activities. To this end, the Excellence Programme for Interdisciplinary Research constituted an appropriate field of study. Because I was interested in following activities, researchers and students in the Programme, it made little sense to have my physical presence within a limited place be the leading principle. Instead, multiple and strategically chosen field sites situated in time and space were prioritized, hence, correspondences, materials, educational activities and meetings in the Programme were chosen as elements to follow. The ethnographic fieldwork conducted in this study was thus multi-sited with an emphasis on following activities and people across multiple case projects instead of a study in a bounded and confined space.

Multi-sited and strategically situated

The idea of fieldwork as multi-sited was introduced by George Marcus (1995, 1998) and later Gupta and Ferguson (1997) as a critique of the traditional ethnographic fieldwork, in ‘that taken-for-granted space in which an "Other" culture or society lies waiting to be observed and written’ (Gupta & Ferguson, 1997, p. 2). Whereas the role and positioning of the researcher in the field had been critically discussed by other researchers before (Clifford, Marcus, & Fortun, 1986; Geertz, 1973, 1974), the idea of the ‘field’ had somehow not been questioned, but left to common-sense . The term ‘multi-sited’ thus became a way to adjust and redefine the idea of the field and of the objects of study e.g. the ontological and the epistemological status of the field (Gupta & Ferguson, 1997, p. 37). Splitting the field into multiple parts did not only affect the perceptions of the field as a physical entity; it also broke with the perception that the field

could be covered, mapped and represented in its totality (Clifford & Marcus, 1986).

With this change in perception and approach it has become possible to consider fieldwork also as located within new spheres of interdisciplinary work, studying social, cultural and political positions (Marcus, 1995, p. 105). The 'field' can now be reached from your computer (Hine, 2005, 2007), it can be placed across multiple physical locations and political levels - and it *is* something you can take the subway to (Passaro in Gupta & Ferguson, 1997). Strategies of literally following connections, associations and relationships become integral parts of designing multi-sited ethnographic research (Marcus, 1995, p. 97).

In addition to being multi-sited, my fieldwork has also been 'strategically situated' (Marcus, 1995, p. 110). With this term, Marcus refers to studies which, on one hand, could be seen as single-sited, as they move within a limited physical space, but are in fact only local by circumstance, as they are driven more by the attempts to understand something broadly about the system (ibid). As an example, Bruce and colleagues' (2004) study of interdisciplinarity in the Fifth Framework Programme (the research programme of the European Research Council) would resemble an object of study similar to the Excellence Programme. But contrary to my study, their field (had it been a fieldwork) was scattered across the European countries, in the various research projects under study as well as the policy levels of the programme. Thus, the study of educational activities within the Excellence Programme is situated within a rather local and limited setting, however driven by attempts to understand the creation of interdisciplinary activities more broadly. In order to select these strategic sites of research within the Programme, I used criteria derived from traditional case study research.

Field sites/Case selection

Case studies have been criticised for not enabling generalization and therefore not contributing to scientific development (Flyvbjerg, 2006). In many social studies, cases are thus merely used as an extra detailed confirmation of the findings from larger quantitative studies and surveys (Seawright & Gerring, 2008).

Nevertheless, when trying to understand the processes of creating educational activities, case studies are crucial. They are a way to understand the local processes of teaching and learning and of highlighting issues that are seldom reflected in surveys and questionnaires (MacLure, 2006b) . Whereas case studies can be used to answer problems, and do

have an existence which include problems and problem-solving, the essence of a case is usually not it's problem (Stake, 1995, p. 127). Their main contribution is to the increased understanding of a particular field. According to Lattuca (2002) and as our literature study and subsequent review (paper I) has confirmed, there is a scarcity of empirically based accounts of interdisciplinary teaching practices in the peer reviewed literature. This does not reflect the reality and all the interdisciplinary activities happening within all sorts of institutions, and it does not represent the amount of knowledge shared locally among peers. It does, however, affect the accumulation of theories and general recommendations of interdisciplinary teaching and learning. A lack of distinct examples and diverting perspectives enable what Barry and Born refer to as the 'unity of interdisciplinarity', where the term is perceived to have one firm definition instead of definitions and understandings tied to local, heterogeneous practices (Barry & Born, 2013, pp. 4–5).

Thus, within the field of Science and Technology Studies (STS), case studies have been used to show that there is no single way of making knowledge or no universal meaning of a technology. Instead, 'differences and explanations are sought in cultural, social, and institutional elements, rather than in ontological aspects' (Beaulieu, Scharnhorst, & Wouters, 2007, p. 675).

The Excellence Programme was a unique opportunity to study interdisciplinary education in the making over a longer period of time. The many research projects awarded under the same programme made it possible to study variations in activities, within the same institutional frame and thus under equal conditions. While having more than one case project limits the vulnerability of the study (Yin, 2014, p. 64), the variation in the projects with the Programme also called for a multi-part case-study. Having more cases enabled perspectives that would have been difficult to grasp with just one case.

The case projects were selected based on information-orientation, as opposed to a random selection (Flyvbjerg, 2006, p. 230) and intended to represent maximum variation (Neergaard, 2007, p. 30; Yin, 2014), based on criteria, which I elaborate on below:

The PIs of the five projects were placed at the faculties of Law, Health, Science, Social Science and Humanities, respectively. They all collaborated across faculties and across the divide of Science and Health and Social Science and Humanities, however, with strong variations in combinations of disciplines and setup. One project was based in a centre at

Science and collaborating with researchers at three other faculties. Another project was primarily based at Social Science and only collaborating with a few researchers at two other faculties, meanwhile, also collaborating with a sister-project at another Danish University.

The internal project setup also varied: while one case project was divided into work packages, each package representing multiple disciplines; another project consisted of research teams, reflecting each participating discipline. While some of the projects emerged because of the Programme call, other projects were established research collaborations, summoned to the new project. The size and budget of these five projects varied greatly, in line with the research objectives of the projects.

As a further way to secure variation, I chose projects that interpreted the requirement for creating educational activities very differently. One project, for instance, had listed a summer school and enrolment of PhD students as planned educational activities; another project had established an educational 'task-force' to develop a range of different activities, including master courses, networks and summer schools throughout the project period. The timing of these activities also varied: While one project aimed at executing the majority of activities at the beginning of the funding period, other projects expected the activities to lie subsequent to the heavy frontend data collection and analysis. This part of the selection process was possible as I obtained permission to read through the educational sections in the applications of the 18 awarded research projects.

There are elements of this study which would resemble conventional comparative studies. There are multiple cases, within the same institutional frame and a focus on certain activities, which would enable comparison. The differences, however, lie in the approach. Comparative studies usually operate on a linear spatial plane, where comparisons are generated for homogeneously conceived conceptual units and studied in either distinctly bounded periods or separate projects of fieldwork (Marcus, 1995, p. 102). My fieldwork was neither driven by fixed parameters or measuring points. Instead, it was motivated by open research questions, aimed a exploring the multiple ways in which interdisciplinary educational activities are created. The study was therefore an ethnographic fieldwork, which, subsequently, allowed me to compare and discuss activities across the case projects.

Methods

The fieldwork in-, across and beyond the five case projects consisted of participatory observation, single- and focus group interviews as well as documents e.g. material from courses, evaluations, applications and email correspondences. As the main part of this material is discussed in the four papers, this section will merely provide an overview of the material and of the areas not covered in the papers.

The Pi's were gatekeepers for my fieldwork in the projects; they needed to approve my presence and they were also the ones in charge of the research applications and thus the written intentions of creating educational activities. Meanwhile, in four out of five projects, the tasks of planning the educational activities were delegated to another researcher in the research project; these researchers thus became natural informants. Finally, the PhD students in the five projects were chosen as a group of informants. This was partly due to them being one of the educational elements that the projects could choose; partly because in several cases, the PhD students were themselves responsible for planning and teaching courses, related to the research projects (see paper II).

Observations

On the timeline (table 2), my fieldwork is quite evenly distributed over blue and green squares, illustrating participatory observation and interviews, with slightly more interviews than observations. This was not anticipated from the beginning. Initially I intended to let the observations take center stage in the fieldwork as I wished to observe a range of planning-meetings and be able to follow the activities e.g. courses and programmes from the planning stage and through to evaluation. There were two reasons for why these intentions were not met:

First of all, most of the planning in the five case projects took place in the offices of the PhD students or individual researchers assigned to plan and execute the activities. This came to my attention through the interviews with the PI's and PhD students. It thus made more sense to interview the researchers than to observe them. Second of all, it became very clear that the educational activities in the research projects were often not very coordinated. As described in paper II, many of the activities that were closely related to the interdisciplinary practices had not been anticipated in the initial project applications and were therefore not picked up in the Programme evaluation either.

Table 2: Timeline of fieldwork

Year	Month	Case 1	Case 2	Case 3	Case 4	Case 5	Programme
2013	Nov	Project applications					
	Dec						
2014	Jan						
	Feb						
	Mar						
	maternity leave						
2015	Jan						
	Feb						
	Mar						
	Apr						
	May						
	Jun						
	Jul						
	Aug						
	Sep						
	Oct						
	Nov						
	Dec						
2016	Jan						
	Feb						
	Mar						
	Apr	Mid-term evaluations					
	Scientific Exchange						
	Aug						
	Sep						
	Oct						
	Nov						
	Dec						

	Observations
	Interviews
	Teaching

I came to know about the activities through interviews, by coincidence, as part of conversations with other researchers linked to the projects, or by tracking and linking up with the course-responsible researchers over email. In two cases I was able to follow the entire process from the initial planning and through to evaluation; however, in most cases, I only heard about the

activities in time to receive evaluations, read through the course material and subsequently interview teachers and students from the courses and activities. My research question of how researchers from various disciplines partake in the creation of interdisciplinary educational elements was thus answered in another way than expected, based on the *lack* of planning-meetings instead of on the observations of these. This is a good example of how case studies are also suitable for testing and debunking hypotheses (Flyvbjerg, 2006). Hence, my observation field notes derive from the few activities I was able to follow from beginning to end (of which one example is used in Lindvig & Ulriksen, 2016), in addition to network meetings among the junior researchers, larger project meetings and workshops in the projects as well as observation notes from the annual gatherings in the Excellence Programme.

While my presence at the various meetings and gatherings in the case projects was approved by the PI's of the projects, most often I was invited to the events by my interviewees, who would mention it during an interview or forward me the invitations on email. In a few cases, I was also invited and asked if I would contribute to the agenda by presenting my research and findings. Whereas I saw these invitations as signs of me being welcomed and included, I mostly declined by offering instead to present myself briefly. As with all participatory observation, being present in a setting inevitably has implications and consequences for what is taking place, as the observer must necessarily interact with and, hence, have some impact on those studied (Emerson, 2011, p. 4). Nonetheless, I attempted to play as little a role as possible. In settings with only a few researchers present, I always introduced myself in the beginning and described the development project and my PhD project. At the larger meetings where no initial rounds of presentation were made, I would only introduce myself if the researchers were discussing confidential research and needed to have a non-disclosure agreement confirmed.

My affiliation with the development project and my background in educational studies also gave me an 'expert' position in some of the planning meetings. I was thus occasionally asked to share my opinion of the course plan or the assigned readings of interdisciplinary texts. In these situations, when asked directly, I replied to the best of my knowledge, but otherwise kept a low profile.

Interviews

Throughout my fieldwork I conducted interviews with a total of 79 informants (see table 3). Across the five case projects, I followed three groups of informants: the PI's and Co-PI's of the case projects, faculty

appointed as responsible for the educational activities and students at various levels. In addition to these informants, I also interviewed informants from the university-management team, who were involved in the planning and administration of the Programme.

Table 3: Empirical material from fieldwork

Level	Description	Case 1	Case 2	Case 3	Case 4	Case 5	Total
Master-level	Interviews Conducted as: - Single (S) - Focus-group (FG)	11 students 3 interviews (FG)	4 students 2 interviews (FG)	4 students 1 interview (FG)	2 students 2 interviews (S)	2 students 1 interview (FG)	23 students 9 interviews
		5 teachers 3 course-planners	3 teachers /course-planners	2 teachers /course-planners	2 teachers 2 course -planners	3 teachers	18 teachers 18 interviews
	Documents	Material for 1 MA elective course and 2 summer school courses	Material for 2 MA elective courses and research apprentice-ships	Material for 1 MA elective course	Material for 2 MA elective courses and student-driven, voluntary group sessions	Material for 2 MA elective courses	Material from 8 MA elective courses, 2 Summer School courses, research apprenticeships and student sessions
PhD-level	Interviews Conducted as: - Single (S) - Focus-group (FG)	9 students 4 interviews (S=1, FG=3)	3 students 2 interviews (S=1, FG=1)	5 students 3 interviews (S=2, FG=1)	4 students 4 interviews (S)	4 students 1 interview (FG)	25 PhD students 14 interviews
Manage-ment level	Interviews	1 Project leader 1 Educational manager (interviewed twice)	1 Project leader 1 Project manager (interviewed twice)	1 Project leader	1 Project leader (interviewed twice) 1 Project-manager (interviewed twice)	1 Project leader 1 Project-manager	13 interviews
	Documents	Mail correspondences, timelines, description of work packages, intended educational activities and self-reports for the mid-term evaluation.					
All case-project levels	Participatory observation	Classroom observation Meetings in educational planning group	Classroom observation Workshop for young researchers	Meetings in educational planning group Young Investigator network meeting	-	Annual research meeting in project	
Pro-gramme level	Interviews	Interviews with members of the Programme-management team					
	Participatory Observation	Observations of annual network meetings for all 18 projects in the Excellence Programme					
	Documents	Mail correspondences with members of the Programme-management team. Background documents on the Programme e.g. calls in Danish and English, timelines, decision papers. Written sections on educational elements from 18 research applications and midterm evaluations, these 5 cases included. The access to and use of the written sections was approved by the project PI's and provided by the university research section, led by the Pro-Rector of research.					

My access to the informants went through various channels: The PI's were approached in the very beginning as part of selecting the five case projects. Through the interviews with them, I was directed towards faculty, planning the courses and other researchers perceived by the PIs to be central to my inquiry. This did sometimes lead me astray, as I would be linked to researchers central to the coordination of the research activities, however, with no role in planning or teaching the educational activities. Nonetheless, meeting these researchers often provided me with other useful information, such as overviews of the planned meetings and activities in the projects and contacts to PhD students with certain teaching responsibilities etc.

The interviews with the faculty responsible for the teaching activities proved very useful in terms of gaining access to course material and evaluations of the activities. These interviews also clarified the role of the educational activities in the case projects and whether the educational activities were considered central or peripheral to the researchers in the projects (see paper IV for perspectives on this).

The interviews with the PhD students were planned in two ways: initially I mapped all the PhD students affiliated with the five case projects by using the project staff lists from the project sites online. I then contacted the PhD students individually over e-mail, describing my project and asking for an interview. From this, I received replies from 39 PhD students and ultimately interviewed 25 (see paper III for a further description of these interviews). The remaining PhD students declined for various reasons: sick leave, maternity leave, scientific exchanges, a lack of time or lacking sense of affiliation with the case project in question.

Another group of informants was the students at bachelor's and master's levels, involved in the case projects through courses, or in writing their theses connected to the projects. I also interviewed students enrolled in research apprenticeships or identified as 'hang-around' students in the projects (see paper II). These interviews (which are described and elaborated on in paper III) not only gave me insights to the courses and the degrees and types of integration in the activities; the students perspectives and discussions in the group interviews also helped me understand how interdisciplinarity was named, identified and viewed across courses, case projects, departments and faculties.

Documents

The study of documents has earlier been detached from the work in the field (see Hine, 2007; Marcus, 1998); however, the re-contextualization of the 'field' has also included new ways of approaching and including documents as part of the fieldwork (Hammersley, 2010; Marcus, 1995; Silverman, 2011). Even though documents are not illustrated in table 2, they played a pivotal role in my fieldwork.

Having access to the 18 research applications in the Excellence Programme not only enabled the selection of case projects; together with the mid-term evaluations they also highlighted differences between intended and realised activities across the case projects. Throughout the fieldwork, documents such as course plans, evaluations, agendas and emails also proved important conversation starters and tricked discussions in the group interviews. As Jacobsson (in Silverman, 2011) states, people

never engage with documents in a neutral way, stripped from context. This is why documents need to be studied *in situ* while acknowledging the local context that shape how people write and read documents (ibid 2011, p. 157).

As will be shown in paper IV, the documents in my fieldwork have been interesting because of their content, but also because they have shaped the social settings under study. The template for self-evaluation that was part of the mid-term evaluation in the Excellence Programme shaped the naming and identification of interdisciplinary activities, just as the PhD programmes and regulations have impacted the expectations for the PhD students in the case projects (as discussed in paper III). As such, the documents have not only worked as 'background material' in the fieldwork (Silverman, 2011) - they have played a key role.

Analytical framework

> Imagine that I am a bit of an academic vandal, in the nicest possible and disciplined way. I take, develop or invent ideas (while immersed in the data) and throw them in a 'what if?' kind of way, at the ethnographic data – the real world of the nitty gritty, the messiness of everyday life – to see what analytical points bounce out on the other side, pick them up again and throw them in again. The problem with many empirical data, empirically presented, is that they can be flat and uninteresting, a documentary of detail which does not connect with urgent issues. On the other hand the 'big ideas' are empty of people, feeling and experience. In my view, well-grounded and illuminating analytic points flow only from bringing concepts into relationships with the messiness of ordinary life, somehow recorded. (Willis, 2000a, pp. x–xi)

Even though the quote from Willis is a bit long I choose to include it as it is a very precise description of my analytical approach in this PhD project. In his book 'the Ethnographic imagination (2000b), Willis draws on Charles Wright Mills' theory of 'the Sociological imagination' (2000, first edition 1959). The emphasis in Mills' and thus also Willis' work is on the connections between the object of study and inspiration derived from the social, everyday life. To Mills, the sociological imagination was a critique of the lack of linkages between sociological studies of societal institutions and the individuals living according to and in relation to these institutions (Mills, 2000, p. 5). Possessing a sociological imagination was therefore to be able to understand the larger historical scene in terms of the meanings at local and more individual levels of life and being. In the quote above, Willis translates the critique towards ethnographic work which is not somehow

linked to urgent issues. In doing so, he calls for experiments of combining observational data from real life with outside concepts, images, metaphors strategically or inspirationally chosen, in order to 'put the subject on the table' (Willis, 2000b, p. 119). Since these images, metaphors and concepts depart from various disciplines, fields of research and popular cultures, they are thus not applied by their ontological positions, but by their use as ideas, inspiration and outside input.

Unsurprisingly, this way of approaching the analysis aligns with the ideas of bricolage where the emphasis is also on using aesthetic and material tools and deploying 'whatever strategies, methods, and empirical materials are at hand' (Denzin & Lincoln, 2005, p. 4). This is not to imply that 'everything goes' and can be used without arguing for its relevance. On the contrary, it is a way of securing transparency as every use of method and strategy must be argued according to the empirical material in question (ibid). The common denominator across these approaches is thus the emphasis on unfolding and highlighting the empirical material instead of using the empirical material merely as backing for existing theories.

Inspired by these ideas of sociological, ethnographic imagination and the researcher as a bricoleur, I too have 'thrown' different outside concepts at my empirical material. First of all, I have used the concept of 'othering' as a sensitizing concept (coined by Blumer, 1954), spanning across the reading of all the material and in writing the four papers. Secondly, I have employed various metaphors, images and concepts to the individual analyses and papers.

'Other' as analytical concept

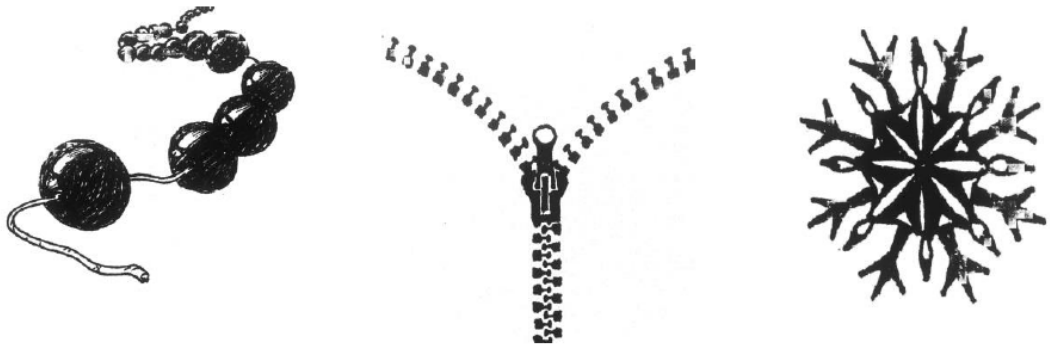
The concept of 'other' has been used before in discussions of interdisciplinarity (see Augsburg & Henry, 2009; Rodgers, Booth, & Eveline, 2003). However, in this project the term proved useful not only as part of the conclusion, but also as a concept to think with, and as a lens to explore processes and practices through.

Whereas MacLures descriptions of education's 'other' (2006a) was an obvious source of inspiration, the term was also inspired by postcolonial writers such as Edward Said (1979). In his now classic work 'Orientalism' (1979), Said surveys the Western attitudes towards the East, and describes how Orientalism, the study of the Orient, is a European creation constructed to deal with the otherness of Eastern cultures and beliefs. The process of creating the 'other', Said argues, is done through three steps: homogenising (suggesting all were the same); feminising (suggesting the 'other' was the lesser of the two) and essentialising (suggesting underlying

characteristics in a reductive fashion) (Gallaher, Dahlman, Gilmartin, Mountz, & Shirlow, 2009, p. 329; Said, 1979, p. 54).

The concept of the 'other' was used throughout the PhD project, but in various ways: after conducting the literature review and writing up the analysis, the concept became a way to read and understand the material. As the analysis in paper I show, the interdisciplinary teaching practices described in the articles were extremely heterogeneous, spread across research fields and levels and applied for a variety of reasons. Despite these differences, the teaching practices and methods were still described, as if they were part of one entity in opposition to monodisciplinary teaching practices. In this, we saw practices of homogenising and essentialising interdisciplinary teaching practices, in order to make it different from monodisciplinarity. Working with the fluffy divisions of mono- and interdisciplinarity depicted in the articles also inspired me to create metaphors of interdisciplinarity that somehow cut across this binary couple. We therefore made use of three illustrations (see figure 4 below) that we originally created for the Danish article (Lindvig & Ulriksen, 2016), in order to describe other ways of understanding the teaching practices at play in the reviewed articles.

Figure 4. Illustrations applied in paper I, originally used in (Lindvig & Ulriksen, 2016)



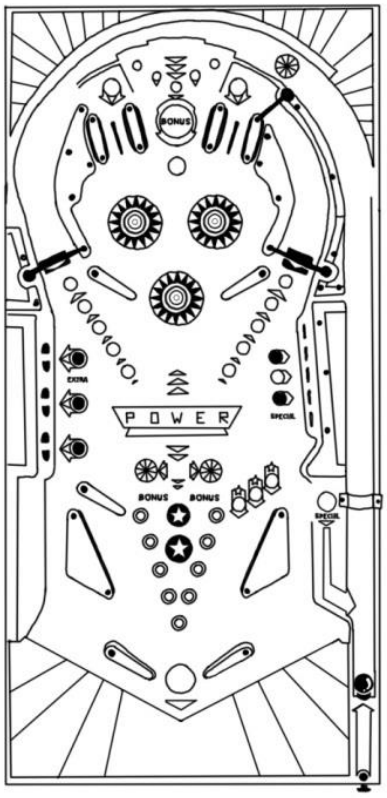
In other analyses (paper II and III) 'othering' as a sensitizing concept was used to highlight areas that were somewhat hidden or overlooked, e.g. the different and more peripheral outcomes of the Excellence Programme. This way the term inspired us to approach the analysis of educational activities through other routes than the officially documented. By doing so, the plethora of activities not covered by the official documents and evaluations (as described in paper II) became visible.

Furthermore, the concept worked as an inspiration in terms of thinking of ‘othering’ as a productive move. This is also how queer theorists (e.g. Butler, 2011; Mohanty, 2003) have used it; as a way to challenge normative categories and to move the ‘other’ to the center (Gallaher et al., 2009, p. 333). Through this perspective, we became attentive to the unclear framing of interdisciplinarity in the Excellence Programme and how this framing caused performative effects and products at the very ground levels of research (see paper IV for this analysis and discussion).

In addition to the concept of ‘othering’, ‘the implied student’ coined by Ulriksen (2009) was used as a sensitizing concept in the analysis behind paper III. This analysis focused on the PhD students as examples of interdisciplinary educational activities, and ‘the implied student’ was thus guiding the analysis of how the students navigated in, by and through the expectations raised in the research projects (see paper III for more details of the concept).

Metaphors and images

Metaphors and images were used throughout the project: as part of the interviews with PhD students exercises involving images and drawing were introduced (see paper III). In analysing and presenting the empirical material, metaphors and images were applied, e.g. the description of interstices from economic theory (Penrose, 2009) and the metaphor of walking in the city (de Certeau, 1988) applied in paper II.



Additionally, there were also images used to think with and through that never made it to the papers. An example of this was the ‘pinball machine’. The image of the pinball shot through a course filled with obstacles, depending on serendipity, skills and luck in order to make it to the high scores, somehow inspired us in trying to understand processes, practices and products resulting from an unclear call for interdisciplinarity, situated within monodisciplinary structures.

As the analysis developed and was eventually situated within the field of

Science and Technology Studies, the Pinball machine was just one in many ways that made it possible to get to grips with ‘the messiness of ordinary life, somehow recorded’ (Willis, 2000b, pp. x–xi).

A final example of the use of images and metaphors in the PhD project is the tool CoNavigator. As also described in the news article in the appendix, CoNavigator was a tangible outcome of an attempt to answer the following question, which guided the collaboration between David Earle, Line Hillersdal and I:

> How can we communicate across disciplinary and methodological divides without compromising, reducing or oversimplifying our research and without losing face or academic identity?

CoNavigator has thus equally worked as a deliverable from the development project and a result of the research process. Whereas the role as researcher often becomes one of criticizing and addressing affects and consequences of certain practices, developing this tool has been a way to not only understanding the findings from the research, but also to test our assumptions and blind spots. We have definitely not answered our question yet; we have, however, immersed ourselves in the field in a more direct way than had we only stuck to writing papers and theorizing upon it.

CoNavigator in action (image: David Earle)

Positioning the researcher in the field

Throughout the fieldwork and the PhD project I was positioned in many different ways. This was not only due to the location of the fieldwork (within the same institution as I was employed) or to the fact that I was part of a development project, driven by an imperative to improve interdisciplinary education within UCPH. My positions were also caused by me being a PhD student with a master's degree from another university (structured differently than UCPH) and from my object of study – interdisciplinary education related to research.

The role as insider is described by Adriansen og Madsen (2009) as someone who is 'considered an insider by the other members of a community and/or who participates on a par with the other members of that community' (ibid s. 147). A double insider is someone who is not only part of the community, but also part of the scientific discourses under study e.g. a geographer studying geographical discourses of research, inside own community of geographers (ibid 2009).

Taking these definitions as starting points, I was a double insider when interviewing PhD students from the Social Sciences and Humanities. This was reflected in some of the interviews when the conversation would move towards my research practice and away from the subject, as in this example:

> I: well, I don't think I have more questions, you've been very good at answering them yourselves as well, ehm – is there anything you're wondering why I didn't ask you?
> S: I have been told by my anthropologist supervisor to ask for that question everytime I ended an interview 'is there anything I forgot to ask you?' [laughs] – but no, not really

In this case, I was considered an insider to the community of researchers conducting qualitative interviews and thus assessed on those grounds. In another interview I was seen as a peer, needing assistance in securing variation of informants:

> S: I am just thinking that many of your informants in this case are from the Social Sciences?
> I: You are right, but that's because I have selected the case projects on the criteria of being most different. So this case is the one anchored in the Social Sciences. So there is also a case at Health, and one at Law and one at the Humanities.
> S: So none of them are at Science?
> I: Yes, there is also one at Science,

> S: Okay – well, if you want more informants from Science, you should just call and ask them

While to these PhD students I was considered on a par and sometimes even a colleague, to other PhD students I was equal to them as a PhD student within the same institution, but outsider to their research community. When speaking to the faculty responsible for planning the educational activities, I was a double insider inasmuch as we shared institution and had the same tasks of developing educational activities. In these interviews I would sometimes draw on my affiliation with the development project, in inviting them to explain details and reflections on course planning and teaching.

Another prevalent role assigned to me was that of the outsider. At the large project meetings, I was for instance named 'the didactics woman', the one 'looking at how we communicate in the project' and the one 'making sure we do interdisciplinarity right'. In situations such as these, I would adjust the description only if I sensed it having consequences for further access to informants or observations. Hence, when it once at one of these meetings was implied that I was spying for the university Rector, I corrected it as I reckoned it might have implications for my further fieldwork in the project. In general, though, I didn't consider it crucial or even possible to take on a 'correct role' or have them position me the 'right' way. Rather, I read it as the informants ways of understanding and justifying the position of interdisciplinary education, thus my role of observing it, in the projects (Emerson, 2011, p. 4).

These various roles and positions in the projects have inevitably affected the fieldwork and thus the empirical material produced, confirming that there is no such thing as a neutral and objective presence in the field (Fine & Weis, 1996; Gupta & Ferguson, 1997).

Validity and rigor

> Epistemological, ideological, value-related conflicts shape the questions we ask, the decisions we make about the knowledge we produce. We should not be embarrassed by these conflict, but instead document them as testimony to the complexity of knowledge work. An important dimension of the bricolage involves learning to deal with conflict and ambiguity. (Kincheloe, 2001, p. 47)

In taking on a qualitative, ethnographic fieldwork and being inspired by postmodern and constructivist modes of thinking, the validity and rigor do not lie in the order or linear systematic and objective

approach to research. Instead the rigor and validity is demonstrated by a transparent and open discussion of how the field is approached and perceived, in what position and with what intention (Denzin & Lincoln, 2005; Kincheloe, 2001; Willis, 2000b). In this perspective, and with the re-contextualisation of fieldwork as multi-sited and strategically situated, it would appear as if the idea of a 'universalism of knowledge' (Livingstone, 2003) and 'the voice from nowhere' (Haraway, 1988) had been silenced. Nevertheless, it still seems as if the situatedness of knowledge is considered a limitation and not a premise. Let me give an example: Back in June, when we received the reviews for paper II, one of the comments calling for minor revisions was as follows:

> The process of arriving to the conclusion is a bit messy. There did not seem to be a systematic approach to collecting and organizing all the data. Strands of data were pulled together into a meaningful paper, but it seemed as if a lot of information was overlooked. The authors can address this problem in a limitations section (reviewer commenting paper II)

In the paper we addressed the comments and, as advised, we included a limitations section. The paper is now published and while I am really pleased with the outcome, the problematisation in the comment endorsed particular assumptions and understandings of proper research as ordered, systematic and absolute. And whereas this comment was probably targeting our writing more than the study behind, it still made me go back and reexamine the fieldwork process:

The interviews with PI's, PhD students and faculty planning educational activities gave me knowledge and directions for exploring interdisciplinary education in the making. They provided me with material on the various activities and through interviews with students involved in these activities, I gained further knowledge and perspective on the activities. Through additional interviews with PhD students and observations of meetings in the Programme, more perspectives and details were added. In the midst of the process, reading through the official documents and using them as stepping-stones for further inquiry, it became clear that a range of activities were not documented in the official documents, thus not considered as results. I then went back, interviewed PI's and students again and looked at more material. In December 2016, I finished my fieldwork. As part of the fieldwork I wrote field notes, prepared interview guides and recorded, transcribed and anonymised the interviews. Furthermore, I filled out spreadsheets and created tables to provide overviews of the data.

But the fieldwork *was* messy. There was not a systematic approach to collecting *all* the data. Strands of data *were* pulled together into a hopefully meaningful paper and in that process a lot of information *was* without a doubt overlooked (as now also addressed in paper II). However, if the fieldwork had been more systematic, perhaps in sticking to the official documents and only choosing cases and material that were linear and comparable, it would not have been possible to gain the knowledge on which paper II is founded: that interdisciplinary activities grow in the interstices, are not always caught by the official assessment structures, yet do add value to the institution and to students and researchers involved.

Hence, the value of paper II lies in the findings that arose exactly from the mess and the everyday practices constituting the fieldwork. This is not to argue that there are not limitations in my fieldwork. On the contrary; there are all sorts of local, personal and messy interferences in the material. It is merely to concur that while these circumstances should be addressed in order to show and secure validity and rigor, they ought not to be seen as problems, but as prerequisites for research. The combination of mess, serendipity and situated knowledge is necessary in order to add something new to our understanding of the field (Haraway, 1988; Kincheloe, 2001; Law & Mol, 2002; MacLure, 2006a).

3

PAPERS

Papers

This part consists of four papers, of which one is published, two are under review and one is submitted to peer reviewed international journals.

The first paper is a result of the literature study conducted for the framework project in the development project 'Interdisciplinary Education'. In the paper, the literature study is described, followed by a discussion of the findings from the reviewed papers. Whereas I conducted the literature study alone, Lars Ulriksen co-authored the analysis and discussion of the findings. Furthermore, Assistant Professor Jesper Bruun helped me sort and understand my initial findings through the creation of networks, based on a coding of the articles. Paper I is thus equally the result of a process with a steep learning curve as it is a review of empirically based peer reviewed articles on interdisciplinary teaching practices in higher education.

The remaining three papers in the thesis each represent a certain aspect of interdisciplinarity created within monodisciplinary structures. Whereas paper II focuses on educational activities such as elective courses, summer schools and research apprenticeships, paper III centers on the PhD students affiliated with the five case projects and on the expectations they encounter and are co-creators of in the research projects. In paper IV, the Excellence Programme as a whole is considered, in discussing the outcomes and future repercussions of strategically applying interdisciplinarity as an unclear concept, in order to cover of a wealth of differing motivations. Even though these papers might seem very different in scope, they all place emphasis on activities, negotiation and meaning making taking place in the interstices and in the intersections of monodisciplinary structures and interdisciplinary projects. Furthermore, the three papers all seek to address gaps in the literature.

Paper II is a mapping of the educational activities created by the five case projects and of the total 18 projects in the Excellence Programme at UCPH. As a way to put the local findings into perspective, the findings are compared to those of a UK based study of interdisciplinary provision in Higher Education, conducted by my paper co-authors Catherine Lyall and Laura Meagher (Lyall, Meagher, Bandola, & Kettle, 2015). By focusing on the multiplicity of interdisciplinary activities created within monodisciplinary structures, we attempt to address a body of literature, which so far has mainly looked at institutions that were meant to be interdisciplinary *or* individual interdisciplinary courses and programmes.

Paper III adds to the extensive focus on graduate and doctoral students in the literature, however, with an emphasis on the implied PhD student and the expectations raised by the double affiliation of project and university, organised in different ways and pushing for different outcomes from the PhD students. Even though this institutional setup might be different from most interdisciplinary research projects, the double affiliation of PhD students, enrolled in a department, but working in a research project is recognised as an occurring issue beyond a Northern European setting.

Paper IV is co-authored with Line Hillersdal and based on empirical material from our individual fieldwork in the Excellence Programme. Whereas literature within Science and Technology Studies (STS) has focused on the institutional and political levels of interdisciplinarity, and on the collaborative aspects of interdisciplinary research, less attention has been paid to the local effects and outcomes of the higher levels of strategically funding interdisciplinarity. In this paper, we thus take a double focus in exploring the meta- and micro levels of interdisciplinary research, education and collaboration. Although this paper takes a wider approach than the remaining papers, and also includes empirical material on research practices, it is, however, still with an eye for issues driving and impeding interdisciplinary educational activities, including the education of PhD students.

PAPER I

Different, difficult and local: A review of interdisciplinary teaching practices

Katrine Lindvig & Lars Ulriksen
Review of Higher Education

Different, Difficult and Local: a Review of Interdisciplinary Teaching Practices

Abstract

This review addresses the lacuna in the literature concerning empirical evidence of interdisciplinary teaching practices by analyzing peer-reviewed articles discussing interdisciplinary teaching practices. The article reports on the wide array of purposes, approaches and designs of interdisciplinary teaching and learning found in the review, but an important, more general, point is that interdisciplinary teaching is, consistently, considered different from normal practices, hence positioning interdisciplinary teaching and learning as the other*. This othering could be detrimental to establishing sustainable interdisciplinary educational provision. Our analysis suggests a need for stressing interdisciplinary practices as local, rather than as generalizable propositions.*

Introduction

To systematically review interdisciplinary teaching practices is a difficult endeavor since "interdisciplinarity is a slippery term, which is reflected in the many alternative names and definitions that are constantly being added to the field" (Moran, 2010, p. 14). In its widest definition, *interdisciplinarity* means any form of dialogue or interaction between two or more disciplines (Ibid), which - when examined as a practice - makes it difficult to pin down and examine systematically.

Reading through the published literature confirms this. The lack of empirical evidence of interdisciplinary teaching and learning is a recurring theme (Haynes & Leonard, 2010). Authors highlight the history of studying interdisciplinarity, where "interdisciplinary teaching and outreach activities were largely ignored" (Creamer & Lattuca, 2005, p. 6) and interdisciplinary education is seen as a "black hole" (Mansilla, 2005, p. 18). There have been calls for more systematic studies of interdisciplinary classrooms (Nowacek, 2005, p. 251) and "rigorous research about learning barriers, outcomes and concrete interventions to support interdisciplinary development" (Richter & Paretti, 2009, p. 29). As Rhoten, O'Connor, and Hackett concluded, "we are left with many aspirational assumptions and

theoretical propositions about creativity and interdisciplinarity but few empirical explanations […]" (2009, p. 85).

Since teaching practices are widely discussed in local pedagogical units, in instruction books, national reports and accreditation schemes, this lacuna in the research literature spurred our interest. This difference between the oral and written accounts, combined with the authors' experiences from a larger research and development project that aims at strengthening interdisciplinary teaching and education at University (anonymized for review) prompted us to ask the following question: If a faculty member from any given discipline, with no prior experience in interdisciplinary teaching, is planning an interdisciplinary course what can they learn from previous empirical examples? In order to answer these questions, we conducted a literature review, specifically searching for empirically-based descriptions of interdisciplinary teaching. We further wished to explore how interdisciplinary teaching practices were portrayed in this literature and the implications of this. Consequently, this article considers both the choice and consequences of various review approaches, the process of assessing the selected literature, and our analysis of the search findings.

Methodology

The review process may take many forms depending on the academic field, the type of literature and the aim of the study. The narrative review, the systematic literature review and the quantitative meta-study are still among the most commonly used (See Tranfield, Denyer, & Smart, 2003 for an elaborated overview). In order to situate our review within the field of varied methods, we have created a diagram (Figure 1) that illustrates the extremities of the review-genre with the two axes representing materials and methods, respectively.

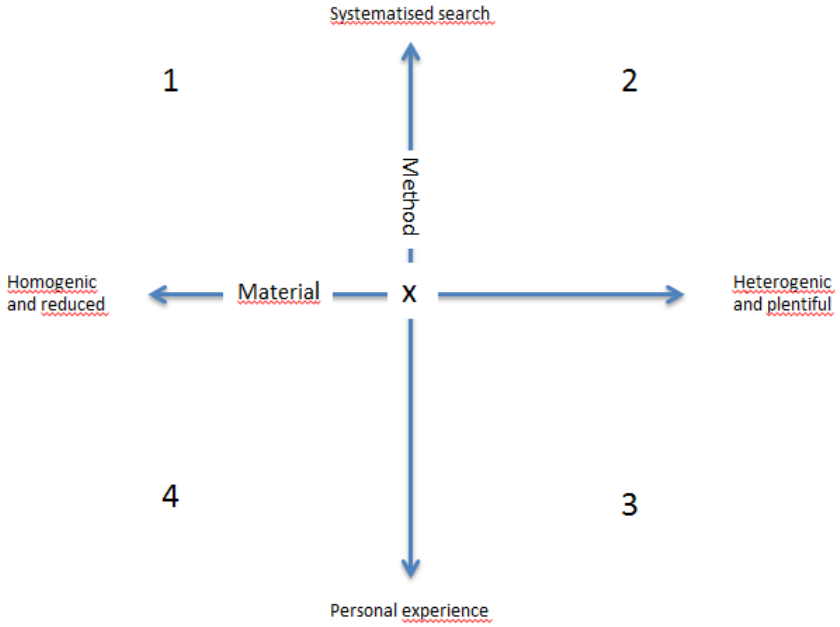


Figure 1: The field of review methods. The numbers indicate four types of reviews: (1) the systematic review, (2) the qualitative meta-studies, (3) the scoping study (4) the berry picking or snowballing approach.

Our diagram is made with a very present awareness of the lack of *"*consistent definitions of these different review 'animals'" (Arksey & O'Malley, 2005, p. 3), yet as an attempt to clarify some of the differences between them. The *material* axis spans between *homogenic and reduced* and *heterogenic and plentiful* and the method axis between *systematized search* and *personal experience*. Within this diagram we have identified four types of reviews (illustrated by the numbers 1-4).

The first type is the systematic review, where the aim is to select and compare the literature according to very strict parameters, in order to reach a conclusion as unambiguous and tight as possible (Davies, 2000). These reviews are often used within the health sciences for mapping illnesses, treatments, side effects etc.

The second type is the qualitative meta-studies. The name 'meta-studies' can cover many different types of reviews, yet they all have a systematic and stringent search in addition to a large and wide quantity of material as common denominator (Walsh & Downe, 2005). What makes these studies different from the systematic reviews is, firstly, that they gather a much wider variety of literature and material with the aim of creating detailed

overviews of the field; secondly, the studies take a qualitative approach, though the modes of analysis vary from discipline to discipline (Finfgeld, 2003).

A third type of review is the scoping study where the aim is to "rapidly map the key concepts underpinning a research area and the main sources and types of evidence available" (Arksey & O'Malley, 2005, p. 5). The outcome can be very heterogenic and closer to a personalized than a systematic approach, since the idea is to approach the study in whatever way works best; in other words, there is not one best practice within this method (Ibid). The fourth type of review methods differs in the type of material selected and included. Methods aiming for homogeneous material and based on a more personalized approach are sometimes referred to as the *berry picking approach* (Bates, 1998) or *snowballing* (Biernacki & Waldorf, 1981). Reviews that fall into groups three and four could take diverse forms, for example pilot studies that precede systematic reviews, accumulated lists of references or of literary canons. Though these methods differ substantially from the systematic review and the meta-analysis (and could be regarded as very normative), they are, nonetheless, used by most researchers in their everyday work of collecting literature for researching and teaching, and therefore parts of the review landscape (Arksey & O'Malley, 2005; Bates, 1998).

All four review types carry strengths and weaknesses: Systematic reviews risk reducing the parameters so much that important findings are missed; direction, possible patterns and points can be lost in the size and breadth of meta-studies and finally there is the risk that reviews primarily based on berry picking and experience create blind spots and closed circles.

Trying to accommodate for these risks, our choice of method is placed in the middle of the four extremities. Our focus on peer-reviewed journal articles, written in English, and accessible online potentially reduces the amount of material available. Yet, it is also heterogenic and plentiful because we have used several search engines, spanning all academic fields which yield a very diverse group of articles. As to methods, our review is in the center because we have conducted a very stringent search on nine search engines as well as a second search inspired by the berry-picking approach. Finally, our analysis and the aim of the review lie between a thorough mapping of the field and a more qualitative scoping analysis of the results of the search. After this initial description of the location of this study in the broader review field, the following section provides a more detailed description of our review process.

Search process

The concept of interdisciplinarity goes by many names. Therefore, to test the adequacy of our search strategy, we conducted a pilot search with a limited set of search terms (e.g. interdisciplinary, teaching, higher education). In this first round, we found only a few articles with an actual empirical view focusing on higher education. We therefore specified the search terms and added a few more, in order to meet the criteria (see Appendix 1 for full list).

In the second round, we worked in two steps: In order to get an overview of the field, we used the berry-picking approach. We started with a few well respected references within the field of interdisciplinary education (e.g., Augsburg & Henry, 2009; Creamer & Lattuca, 2005; Davis, 1995; Frodeman, Klein, & Mitcham, 2010; Klein, 2010; Lattuca, 2001) and worked our way down their reference lists, following different leads and keywords, in order to get a sense of the field. This search included books, local assessment reports, student evaluations, policy papers and teaching material in different languages. This preliminary search gave us a total of 1,018 hits.

Simultaneously, we conducted a systematic search in nine online databases (ERIC, AUEI, BREI, Education Research Complete, Project MUSE, CBCA, SCOPUS, Web of Science). Based on the experiences from our pilot search, we used a range of different keywords, such as *multidisciplin*, interdisciplin*, integrated learning, crossdisciplin* (*see Appendix 2 for full list) and combined these with words indicating the empirical aspect (e.g., *empirical, methods, data collection*). As a third parameter, we combined them with *higher education, university and tertiary education, student, teacher.* We combined the keywords in different search strings, adding and subtracting words in order to get different hits. In our first selection process, papers were included if they were published between 2000 and January 2014, in English and had an empirical perspective. This search gave us 2,175 hits.

Together, these searches yielded just over 3,000 references. Reading through the abstracts and methods section of these references, excluding the ones that did not fulfill the criteria (e.g. books and non-peer reviewed articles, book reviews and meta-studies), resulted in a total of 101 peer-reviewed articles, accessible online, written in English and based on empirical evidence of interdisciplinary teaching in higher education. This group of articles forms the basis of our analysis.

Coding procedures and analysis

In most cases, a meta-analysis is used for collecting literature from within the same field or discipline. The central search criteria might be a theme, an illness, a treatment, a political issue or an historic event (Jensen & Allen, 1996). In our case, the common denominator was *interdisciplinary teaching practices*. This resulted in articles spanning the entire academic field. In many of the articles, the focal point was something other than teaching, and the description of teaching and planning was not even a key feature of the article. Because the articles were written following different academic traditions, the outlines of the articles also varied considerably. What one article described in two pages might only be mentioned in a sentence in another. We therefore conducted a very detailed reading of the articles, focusing just as much on the appendices and methods sections as on the abstracts and conclusions. It also meant that we kept articles with a different focus, as long as they entailed an empirically based account of interdisciplinary teaching.

Articles were indexed in a table (see Appendix 3) and coded thematically in order to map overlapping trends (see Figures 2 and 3).

Figure 2. Sticky notes forming a map of themes. Figure 3. Sticky notes sorted in final themes

The coding synthesized findings across the articles and across the different readings (i.e. the table indexing and the sticky notes themes). The codes were not developed beforehand, but based on the generated themes. A specific code was developed for each mentioned type within a theme (e.g. various teaching methods and assessment formats or different course types and levels) and the articles were then coded describing the specific variations within a theme (see Appendix 4 for full list). In our final analysis, these codes served two purposes: First, they helped us generate an overview of the articles – pointing us towards the most commonly used/described methods and teaching constellations. Secondly, they made it possible to detect commonalities between fields, levels, journals etc.

Finally, the coding process led us to exclude 41 articles where the presentation of practices related to interdisciplinary teaching was insufficient to allow for coding. Hence, we ended with identifying a set of 60 core articles.

Replicability and validity of search

It proved extremely difficult to find articles focusing on interdisciplinary teaching; not because the literature does not exist, but because the indexing of the articles and keywords are so inconsistent. While this was already pointed out by Klein (1994) it still came as a surprise that so many articles were missed in the systematic search (and found by coincidence after the review process had ended). The main reason for this was that the word 'discipline*' did not occur in any variation in the article.

A second hurdle in the search was related to the level of description. Our starting point and reason for conducting this study was that empirically-based knowledge of interdisciplinary teaching was needed, and that the majority of articles mostly deal with descriptions of developing interdisciplinary programs, institutions or methods appropriate across a range of fields. This is confirmed when we look through our articles. Out of the more than 3,000 references found, only 101 articles did in fact focus on interdisciplinary teaching practices and out of these, only 60 articles involved concrete cases and empirical examples. Therefore, the following section is based exclusively on these articles.

Findings

This section is divided into three distinct parts: In the first part, we present the overall findings that were generated through the coding of the 60 articles. Here, the emphasis is on the varieties of methods, practices and approaches discussed in the articles and thus leans towards the output styles of systematic reviews and meta-studies (area one and two in figure 1) (Noblit & Hare, 1988).

In the second part, we present the findings drawing on three generic metaphors for designing interdisciplinary courses, and in part three we add a meta-perspective by applying theories from outside the reviewed literature (mainly Said, 1979). In these two final parts we lean towards the output styles of more personalized review methods like those mentioned in area 3 and 4 in figure 1(Arksey & O'Malley, 2005; Biernacki & Waldorf, 1981).

Part 1: overall findings

Our findings show that the humanities and the sciences (engineering included) appeared almost equally in about half the articles while social sciences and health sciences were present in about one third of the articles (see appendix 4). While there were no dramatic variations in the occurrence of the different academic fields, the articles were far more concerned with teaching at undergraduate level than postgraduate level or staff development. In terms of teaching and assessment methods, the coding showed that the articles mainly discussed assessment methods that are less commonly used in higher education (e.g., portfolio assessment) and teaching formats with an emphasis on methods where students work with cases or problems. Furthermore, it is noteworthy that team teaching occurred just as many times as lecturing. Even though a count of code occurrences offers some idea of overall patterns in the reviewed articles, a simple quantification may be misleading. Therefore, we will now turn to more qualitative results of our review.

The purpose and scope of interdisciplinary teaching and learning

Looking across the articles it appeared that adopting an interdisciplinary approach to teaching and learning was rooted in different purposes and had various perspectives. A frequently used argument for interdisciplinarity was that monodisciplinary qualifications are insufficient to develop the required competences in university students. Some argued that

contemporary social challenges, such as sustainable development or water resource management, require interdisciplinary approaches (e.g., Michelsen, 2013). Others emphasized that the scientific development has a pace and direction that the traditional monodisciplinary approaches cannot keep up with, e.g. virtual engineering (Häfner, Häfner, & Ovtcharova, 2013), biology (Dymond et al., 2009) and pharmacy (Montagna, Moreno, Verde, & Maifrino, 2011). In brief and across the different examples, the argument was that the students' academic competences would be left wanting in some areas without an interdisciplinary approach.

Another argument concerning competences was that, by offering students the opportunity to work together with students from other disciplines, they would develop competences related to this kind of collaboration (Frank, Aldred, & Meyer, 2012). Furthermore, when the students worked together across disciplines during the courses, they would experience the approaches, methods and ways of thinking of students from other disciplines and through this could develop an awareness of the peculiarities of their own discipline (strengths as well as limitations) and of the potential in other disciplines. An example of this was a course on data analysis in biology that recruited students from different biology-related disciplines (e.g., biology, bioinformatics and biochemistry) and from mathematics and statistics (Tra & Evans, 2010). Another was a course involving engineering students as well as students from, inter alia, sociology and business and economics focusing on life-cycle analysis (Richter & Paretti, 2009). The point of these interdisciplinary teaching and learning activities was to allow students to develop particular competences that would be relevant, but which they would presumably not develop within a monodisciplinary context.
A course joining students of medicine with art students where drawing was used as a way of exploring the human body (Lyon, Letschka, Ainsworth, & Haq, 2013) is an example of a course with the intention that the students would develop particular competences through the interdisciplinary activities, but that the students also would develop disciplinary competences in their own right. The medical students should develop knowledge about the human body, a common competence for medical students, but by doing it in a different way, the competence might also be qualitatively different. Furthermore, the purpose was also to develop the students' competences related to creativity and innovation, something that would be in addition to the classic competences of medical students.

This was a second characteristic found across the articles: to adopt interdisciplinary teaching and learning activities in order to develop

competences in addition to the disciplinary ones. In this case it was creativity, a competence that was also in focus in Rhoten et al. (2009); another example was communication skills for medical students (Simmenroth-Nayda, Alt-Epping, & Gágyor, 2011). However, there were also a number of articles arguing that interdisciplinary teaching and learning foster critical thinking (Tsui, 2002), a reflective approach to knowledge and knowledge production rather than simply passing on existing knowledge (Cook-Sather & Shore, 2007) and challenge the students' perceptions about what science is (Olsen, Bekken, McConnell, & Walter, 2011). Brew (2008) mentioned changes in scholars' sense of affiliation with a particular disciplinary tribe or community and a need for more fluid models of disciplinarity. This suggests that interdisciplinary practices could have more profound consequences for the formation of academic identity and hence for the reproduction of academic cultures.

The justifications for interdisciplinary teaching and learning practices mentioned so far have focused on changes in the disciplines or in the social practices the disciplines are related to. Other justifications stressed the motivational potential, for instance, as a way of getting geology students to learn mathematics (Wagner, 2000) or in the teaching of so-called 'service subjects', such as 'law for business management' or 'information technology in (for) business' (Yang, 2009). Interdisciplinary approaches could spark a sense of relevance and motivation in these contexts. Also, some articles focused on the potential of interdisciplinary approaches for including groups of students otherwise at risk of being marginalized or for kinds of knowledge usually excluded from academia (Brint, Turk-Bicakci, Proctor, & Murphy, 2009; Whimp, 2008).

In other words, the interdisciplinary teaching and learning approach might foster a sense of relevance and motivation among the students. Interestingly, there were also articles noting resistance from students when meeting interdisciplinary teaching and learning activities. Examples included first-year students' reluctance to learn in a different way from high school (Heiman, 2013) 2013), students' previous learning experiences formed by monodisciplinary universities not equipping them to cope with the different design and expectations of an interdisciplinary course (Strain & Potter, 2012), and students not recognizing what they had indeed learned (White, Perlman, Fantone, & Kumagai, 2010).

Overall, the justifications for developing interdisciplinary approaches placed particular emphasis on interdisciplinary learning outcomes as different from the traditional courses. Students develop different competences, and they

experience a different kind of motivation and sense of relevance. In brief, interdisciplinary approaches are *different* from and lead to *other* competences and learning outcomes.

Some articles reported interdisciplinary activities involving disciplines that were rather closely related, for example a course integrating language and literature (Day, 2007) or a focus on including different theoretical approaches (post-colonial theory, feminist theory, etc.) in the teaching of literature (Kaur & Manan, 2013). In both cases, the courses conceived something as interdisciplinary that in other disciplinary environments would be considered belonging to the same discipline. Hence, these two papers revealed the extent of specialization and division between different disciplines within ordinary study programs.
In a similar vein, the paper by Sarsengelding et al. (2013) dealt with the integration of mathematics and physics in the teaching of a physics course. This could be seen as an example of the teaching of service subjects mentioned previously. However, it could also be an example of a course bringing together two elements that have been closely linked in the development of the discipline, but have been separated in the educational context (Uhden, Karam, Pietrocola, & Pospiech, 2012)

Pedagogical and didactical forms

The reviewed articles reported the use of teaching methods with an emphasis on group work, case-based teaching, project-based work and problem-based learning. This does not mean that more traditional lecture-based teaching and learning activities were not found (22 of the articles report lecture-based teaching), but it suggests that interdisciplinary teaching tends to draw on teaching and learning activities that place the students in an explicitly active role, that emphasize collaboration and that organize the content in relation to cases, problems etc. A closer look at the articles added nuances to this picture.

One group of articles presented interdisciplinary teaching and learning activities that were mainly lecture based with some kind of interaction with the students. The teachers were perceived as carriers and representatives of their own discipline and in most of these articles, the interdisciplinary aspects emerged through the students being exposed to a variety of teachers with different backgrounds and approaches. In some cases, the teachers taught in teams (e.g., Frank et al., 2012) or courses were designed with teachers teaching separately, but effective cross referencing made the students experience the course as highly integrated and interdisciplinary (Nowacek, 2005). Elsewhere, professors did not directly

engage in discussions with each other, but rather asked clarifying questions, “assuming the role of ‘superstudent’” (Orillion, 2009, p. 8).

In other cases, the students were the ones expected to enact and realize the interdisciplinarity, often by having students from different disciplinary backgrounds working together at the same course or the students being exposed to teaching rooted in different disciplines (Laster & Russ, 2010).

However, it was more common to organize the interdisciplinary teaching and learning activities in ways that differed from the conventional university lecture. Furthermore, the activities were frequently organized around a specific case, problem or topic (Michelsen, 2013; Pharo et al., 2012; Remington-Doucette, Connell, Armstrong, & Musgrove, 2013; Rhoten et al., 2009), but it could also be a particular method (Lyon et al., 2013) or the history of the discipline (MacKinnon, Hine, & Barnard, 2013) that served as the structuring principle for the teaching. The mutual point permeating these examples of courses was that students should learn to work in an interdisciplinary context applying a variety of disciplinary components by actually doing so and by experiencing a subjective need for integrating different disciplines in order to succeed in dealing with the topic or problem at hand. Students should experience interdisciplinarity as relevant and inevitable.

Interdisciplinarity and the comfort zone of teachers and students

Another characteristic permeating the articles was that the design of the courses did not meet students’ expectations. As mentioned above, some articles noted that students could react to this with resistance because they felt uneasy about the setting and the requirements. Other papers remarked that the different way of teaching, such as team-teaching, had an impact on the teachers’ roles, for example team-teaching resulting in teachers experiencing a loss of control and having to change their habitual way of teaching (Colwill & Boyd, 2008). Colwill and Boyd (ibid.) argued that exactly this sense of discomfort could be considered a core asset of team-teaching and interdisciplinarity, because it could be precisely that which could open the way to designing and practicing innovative teaching.

The sense of uneasiness occurring among some students and some teachers was related to changes in teaching practices and changes in the roles and expectations linked to being a student and a teacher in a particular context. However, besides this feeling of being outside ones comfort zone there could also be a more fundamental issue related to the

development and maintenance of a particular identity as a student, a scholar and a teacher within a disciplinary context. An example of this was a group of lecturers in engineering who, in the process of attending a Master's program in Engineering Education, also had to negotiate their academic identities. They came to the Master's program with the academic identity of an engineer "and approached student learning as an 'engineering problem': how to increase student 'throughput' without lowering engineering standards" (Winberg, 2008, p. 364), but during the program they negotiated and adjusted that identity.

In some cases, this identity component could be experienced as a threat. In others, it was a part of the point with the interdisciplinary component that students combined different disciplinary elements into their academic or professional practice or even developed their professional identity through participation in interdisciplinary practices. While Winberg (2008) dealt with a discipline with a rather strong sense of identity and coherence, where it was challenging to integrate other perspectives, Palaiologou (2010) showed that the common use of 'the discipline' as the basic building stone in academia and in higher education tends to marginalize knowledge domains and educational programs with a more integrative character. Brew (2008) argued that there was a tendency to over-emphasize the importance of disciplines in relation to academics' sense of belonging. Instead, she suggested that we should conceptualize disciplines as something more fluid and changeable than the frequently used metaphors of 'tribes and territories' (Becher, 1989) suggest. Such less fixed metaphors would better capture the actual practices, developments and sense of affiliation found in academic practice. On the other hand, Brew's study concerned academics' sense of affiliation to disciplines as researchers, but the organization of higher education courses, modules and study programs do not necessarily have the same kind of fluidity. Still, the point that particular metaphors affect our conception of what the world of higher education looks like is valid. Furthermore, it is a relevant point that the extent to which higher education programs and courses comply with traditional boundaries differs across different institutions and higher-educational systems.

Part 2: translating the findings

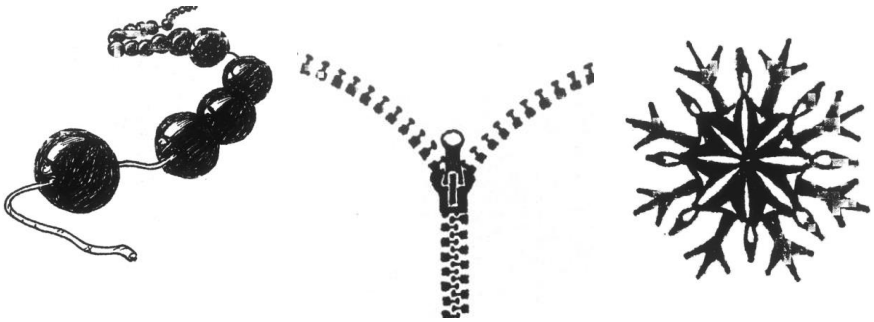
A key finding from our review is the paucity of literature reporting empirical evidence and we can only speculate about why it is so difficult to find peer-reviewed literature on concrete practices of interdisciplinary teaching. One reason could be related to the publication practices combined with our search criteria. We limited the search to peer-reviewed journals in English.

These journals publish papers that are considered of scholarly interest at a more general level than experiences situated in local practices. This means that the editorial policies as well as the self-selection of the authors would favor articles offering a generalized analysis and discussion of empirical experiences. Rather than presenting the nitty-gritty of interdisciplinary practices, the authors would extract the theoretical and de-contextualized points to be made about interdisciplinarity, because that is what is expected by the journals and their readers. Then, the more practical experiences are either not shared or they are disseminated only in informal communication across the table in the coffee room or in small grey papers for a local audience. This, nonetheless, deprives us of the opportunity to consider the diversity of practices and leaves us with abstract conceptualizations and taxonomies.

Further, we found that the justifications and purposes for introducing interdisciplinarity broadly took two directions. One direction was related to the competences that students could develop in interdisciplinary courses. For instance, this could refer to a need for interdisciplinary competences to approach the problems science has to deal with and to acquire a critical awareness of the potentials and limitations of various disciplinary approaches. Another example was the need for students to develop competences beyond the strict disciplinary knowledge, e.g., collaboration with other disciplines. A second direction emphasized interdisciplinary designed courses as being more engaging and motivating for the students.

From the perspective of a staff member about to redesign a course, it is a main point that although these different justifications and purposes for interdisciplinary design of courses are not necessarily mutually exclusive it is still important to clarify in the design process what the main goal of the redesign should be. It is possible to design a course in a way that provides for more than one purpose at one time, but there are also differences in terms of which purposes are better catered for by different forms of interdisciplinary design.

This relates to another point of the review, namely that the design of interdisciplinary teaching and learning activities takes different forms. In a previous paper (Lindvig & Ulriksen, 2016) we suggested three metaphors for ways in which relations of connections and coherences between various elements in interdisciplinary teaching could be established. These metaphors are *pearls on a string, the zipper* and *the snowflake.*



Three metaphors for interdisciplinarity:
1) pearls on a string, 2) the zipper 3) the snowflake.]

The first metaphor refers to interdisciplinary activities where the different disciplinary elements are presented one after the other (e.g. Laster & Russ, 2010; Orillion, 2009). In this design, the students meet individual disciplinary elements separately, but the intention is that there is a string running through the entire course or module tying the elements together. In the second metaphor, the different disciplinary elements are presented separately, like in pearls on a string, but with an explicit expectation that one actor, usually the students, will be the one tying the different elements together. The third metaphor is *the snowflake* (Figure 6). This design organizes the different disciplinary elements around a common center such as a particular social or scientific problem, a method, etc. Problem-based courses or teaching organized around a particular topic are examples of this.

The three metaphors do not constitute a taxonomy of increasing levels of interdisciplinary integration, neither are they hierarchical in terms of presenting ‘more’ or ‘less’ interdisciplinarity. They are conceived as metaphors for the purpose of reflection in terms of identifying what kind of interdisciplinary integration that is explicitly or implicitly adopted in a particular course and for considering what kind of integration that would be the most sensible in a particular context.

Likewise, the three designs have their strengths and weaknesses. While the pearls-on-a-string design runs the obvious risk of the string not being clear or strong enough to link the different elements together, the snowflake design is vulnerable to students remaining in one part of the flake instead of integrating the different elements. Also, the students may be unaware of being engaged in interdisciplinary teaching and learning and therefore not developing the awareness at a meta-level of the implications of integrating

different elements. The importance of this, of course, depends on the purpose of interdisciplinary teaching and learning in the particular context.

If the justification of interdisciplinary educational components is to engage with real-world problems that involves several disciplines, it could be argued that due to the emphasis on the content it is of less importance whether the students develop a meta-perspective on the relations, differences and similarities between the disciplines. Nowacek (2007) argues that interdisciplinarity contains a meta-awareness of disciplines and the integration of knowledge and modes of thinking (with a reference to Mansilla, 2005). In the course, she analyzed, which was of a pearl-on-a-string type, she found that teachers more often linked content from different disciplines to each other than they did ways of knowing. In a snowflake-type course, a similar focus on content could mean that the students realized that different disciplines could contribute with different knowledge elements, but the students would not necessarily become aware of the different ways of knowing.

Nowacek suggests that the links concerning ways of knowing are less frequent because the teachers do not comment on those processes within their own disciplines either. They merely do them. Hence, it also means that it is not necessarily enough that students *do* interdisciplinarity if they do not know they do it: Nowacek (2005, p. 174) makes the point that we need to focus on “the ways in which individuals construct their understanding of both disciplinarity and interdisciplinarity”. Therefore, a snowflake-type interdisciplinary course is not a guarantee that students will develop interdisciplinary competences.

Therefore, there is no causal relation between the way interdisciplinary teaching and learning activities are designed and the interdisciplinarity-related competences students develop. However, some designs offer a stronger invitation to the development of some competences than others, just like they offer a way of reflecting on the opportunities and pitfalls of different designs.

Part 3: theoretical perspectives on the findings

The literature on interdisciplinarity is rich in variation concerning the way the teaching and learning of interdisciplinarity is conceived and practiced and how it should be understood. Still, it is a common thread through most of the reviewed articles that interdisciplinarity is presented as different from the usual way of organizing teaching, learning, etc. in higher education. Henry (2005) notes with a reference to work by Rodgers et al. (2003) that

interdisciplinarity is subject to “an ‘otherization’ process” employed by the disciplines to “disarm the threat of interdisciplines” (Henry, 2005, p. 25).

Interdisciplinarity as ‘the other’

Said’s (1979) study of orientalism made the point that authors and scholars from the *Occident* (The United States and Europe) described the *Orient* (large parts of Asia and the Middle East) as the ‘other’ compared to the Western world through stereotypes that was imposed on the perception of the people and cultures of the orient. In the work of the orientalists, the East was not a geographical area consisting of various countries, peoples and cultures. As ‘the other’, the East was essentialized by suggesting that the region and its people had underlying characteristics, homogenized by the claims of it being one unit and finally feminized by suggesting it was an exotic, barbaric and much less developed opposition to the west (Gallaher, Dahlman, Gilmartin, Mountz, & Shirlow, 2009, p. 329). Through this, the West in the works of the orientalists became the exact opposite of the orient and therefore an equally homogeneous whole (Said, 1979). The othering, hence, maintained an image of the world and the relation between East and West as essentially that of the true and of the other (Said, 1994).

Said’s critique was directed at the Western scholars othering the Orient. Translated to our case the othering of interdisciplinarity would be the doing of the monodisciplinary scholars. However, based on our review, we suggest that the othering is not just something disciplines do to interdisciplinarity. Following Gallaher et al. (2009), othering is also done by the involved researchers themselves when conducting studies in ways which homogenize and essentialize entire groups of people or, as in this case, activities (Gallaher et al., 2009, p. 332). When the protagonists of interdisciplinarity in the papers identified by this review emphasize that interdisciplinarity earns particular merits by being different from the run-of-the-mill disciplinary teaching and learning activities, they at the same time contribute to an othering of interdisciplinarity. As Henry claims, this may cause the interdisciplinary courses and programs to be more vulnerable in times of budget cuts and restructuring not only because interdisciplinarity as ‘the other’ will be perceived as the superfluous elements, but also because monodisciplinarity, as the binary opposite to interdisciplinarity, will be perceived as a constant, static and grounded phenomenon. Additionally, there is the risk of stereotyping interdisciplinarity: rather than acknowledging and pointing out the differences and nuances in the way interdisciplinarity can be conceived and practiced, the literature adds to a particular understanding of interdisciplinarity as something extraordinary. Consequently, named interdisciplinary practices are more likely to be left on

the periphery. This produces a self-confirming prophecy that interdisciplinarity will never be fully acknowledged even though it holds so much promise.

The situated nature of interdisciplinarity

The othering of interdisciplinarity also adds to some of the points we made earlier in this paper. This concerns that teachers find themselves at the border of their comfort zone or beyond, that students in some cases are skeptical when being engaged in interdisciplinary teaching and learning activities and the critique raised by Brew (2008) that disciplines are presented as more stable and consistent than they actually are.

Firstly, the positioning of interdisciplinary teaching as 'the other' to the *right* teaching could spark uneasiness in the first place among teachers and students who might feel insecure facing this apparently very different way of teaching. However, some of the elements that are reported to make the teachers uneasy are rather related to the use of pedagogical formats than to interdisciplinarity. These are formats where students have more influence on the selection of content, the pace, the sequencing of the different elements etc. (what Bernstein, 2000, calls "framing"), and this can lead to a sense of loss of control. Hence, this is not necessarily related to interdisciplinarity as such. It has to do with adopting pedagogical formats that underpin the development of some of the competences, but the othering of interdisciplinarity associates the loss of control with interdisciplinarity.

Secondly, Brew's point concerning the more fluid disciplines calls for an attention to interdisciplinarity as something that is fundamentally situated. What counts as interdisciplinary teaching and learning is a local rather than a global issue. What is experienced as combining content and ways of knowing across disciplinary borders will be perceived differently depending on the local institutional setting. If this is disregarded and all the local practices are instead collected and transformed into generic definitions and understandings of interdisciplinarity, it creates a homogenized and essentialized image of interdisciplinarity that looks distorted compared with other ways of understanding teaching and learning. This is especially true when considering the differences in educational structures and in publishing structures across the continents. In our review, the number of articles reporting from American and Australian contexts constitutes the vast majority, hence leading a generalized image of interdisciplinarity in a direction very different from that of some European higher-education systems. Generalizing on local, situated practices relates to what

Livingstone (2003, p. 142) problematizes as “the apparent universalism of science”. There is nothing wrong in learning from informed practices and transferring knowledge from one site to another, as long as this is done in awareness of it being “less about the local instantiation of universally valid facts and more about the adaptation of local knowledge to create another” (Ibid).

Study programs that consist of modules combined by the students will more frequently identify the students’ difficulties with experiencing coherence through their study path as an issue concerning interdisciplinarity. However, study programs with a number of mandatory modules leading towards a particular degree in, e.g. Chemistry or Sociology, may address the same lack of coherence between, say, Mathematics and Chemistry, or between Economy and Political Science, as a problem within a named discipline. In other words: Are the issues of interdisciplinary education addressed in relation to individual modules of disciplines or sub-disciplines, or are they addressed in relation to study programs encompassing more than one discipline?

There are two points here: First of all, what is considered as cutting across different disciplines could also be considered as the challenge of linking two elements that are naturally related in the practicing of a discipline. Secondly, the othering of interdisciplinarity and the tendency to conceive and describe interdisciplinarity as a single entity conceal the variations.

Conclusions: reviewing articles on interdisciplinary teaching practices

This paper is a result of the reading and analyzing of a collection of articles on interdisciplinary teaching practices. In many ways the collection appears inconsistent due to the various disciplined output styles, incomplete due to search limitations that leave out articles with the right content yet are not caught due to missing keywords, word indexing and interpretations. Above all, it seems incomplete because there is a lot of knowledge that, due to the publishing structures and incentives, are not shared in the output format we have focused on. The implication of this is that those who seek the peer-reviewed literature to find inspiration for the development of an interdisciplinary course have a limited number of examples to use.

The review has not offered the empirical explanations called for by Rhoten et al. (2009). The reviewed articles provided numerous examples,

experiences and reflections that all contribute to an increased and more nuanced understanding of interdisciplinary teaching and learning, but they do not add up to evidence-based conclusions about what works in interdisciplinary teaching and learning and what does not.

Our experiences from the study confirm the existence of a vast and diverse amount of knowledge and experience on interdisciplinary teaching practices that is not disseminated through peer reviewed journals, but is instead present in local formats and practices (e.g. course evaluations, tool kits). In this case, the main repercussion is the act of 'othering interdisciplinarity' that the limited outlet of peer-reviewed literature supports; 'othering' in the sense that through these empirical accounts, interdisciplinarity is depicted as something completely different from monodisciplinarity. The othering of interdisciplinarity that we found in this literature may over-emphasize the different and unusual aspects of interdisciplinary teaching, making it more challenging and risky to support, while at the same time conceal what is particular about applying interdisciplinarity in a given context because the othering generalizes the unusual by simply making it 'the other'.

While this collection might be inadequate, we would nevertheless argue for its importance. A study of the literature on so-called interdisciplinary teaching practices is a fruitful way of getting to know the field, as long as we acknowledge the limitations of generalizability in cases of extremely situated, local practices.

There is, in other words, a need for more peer-reviewed papers that report and analyze specific, empirical examples of interdisciplinary teaching and learning, but do this in a way that emphasizes the particular interdisciplinary practice instead of a general idea about interdisciplinarity. Hence, the label of interdisciplinary teaching and learning may in effect be detrimental to developing, reflecting on and analyzing interdisciplinary teaching and learning. This should not lead to abandoning the use of the term, but it calls for a more accurate and careful use. Then we could proceed with developing and understanding what is at stake in interdisciplinary teaching and learning.

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Appendix 1

Search Terms Used – Second Round

- Interdisciplin*
- Multidisciplin*
- *Disciplinarity
- *Disciplinary
- Cross* disciplin*

AND

- Higher education
- Universit*
- Academic education
- Tertiary education

AND

- Empirical
- Data
- Empirical
- Study
- Methodological approach
- Didactic*

AND

- Students and learning
- Students and teachers
- Science education
- Interfaculty teaching
- Interdisciplinary learning;
- Curriculum Integration
- Interdisciplinary teaching approach
- Undergraduate Study
- Learning Processes
- Integrat* learning

Appendix 2

Search Strings – Second Round

Inclusion criteria:

Geographic area: EU, USA, Canada, Australia

Language: English

Publication type: No limits.

Date: 2000 – January 2014

ERIC
(SU.EXACT.EXPLODE("Interdisciplinary approach") OR multidisciplin* OR crossdisciplin* OR transdisciplin* OR interdisciplin*) AND (SU.EXACT.EXPLODE("Academic education") OR SU.EXACT.EXPLODE("Higher education") OR higher NEAR/3 education OR academic NEAR/3 education) AND (SU.EXACT("Academic Education") OR didactic* OR (education* NEAR/3 theor*) OR (education* NEAR/3 stud*) OR SU.EXACT("Teaching methods") OR SU.EXACT("Teaching models")) AND (empiric* OR (methodological NEAR/3 approach))
Results: 65 hits
AUEI (Australian Education Index)
(SU.EXACT.EXPLODE("Interdisciplinary approach") OR multidisciplin* OR crossdisciplin* OR transdisciplin* OR interdisciplin*) AND (SU.EXACT.EXPLODE("Academic education") OR SU.EXACT.EXPLODE("Higher education") OR higher NEAR/3 education OR academic NEAR/3 education) AND (didactic* OR (education* NEAR/3 theor*) OR (education* NEAR/3 stud*) OR SU.EXACT.EXPLODE("University teaching") OR SU.EXACT("Teaching methods") OR SU.EXACT("Teaching models") OR SU.EXACT.EXPLODE("University curriculum"))

Results: 464 hits
BREI (British Education Index)
(SU.EXACT.EXPLODE("Interdisciplinary Approach") OR multidisciplin* OR crossdisciplin* OR transdisciplin* OR interdisciplin*) AND (SU.EXACT.EXPLODE("Higher Education") OR SU.EXACT.EXPLODE("Academic Education") OR higher NEAR/3 education OR academic NEAR/3 education) AND (SU.EXACT("Teaching Methods") OR SU.EXACT("University Teaching") OR didactic* OR (education* NEAR/3 theor*) OR (education* NEAR/3 stud*) OR SU.EXACT.EXPLODE("University curriculum")) **Results: 292 hits**
Education Research Complete**:**
(interdisciplin* OR multidisciplin* OR cross disciplin*) AND higher education AND empiric* 2000-2014 **Results: 48 hits**
Project MUSE:
Search Results For: All of the terms higher education AND empirical AND educational methods AND (interdisciplinary OR multidisciplinary) 2000-2014 **Results: 440 hits**
CBCA: **(**CBCA Education (Canadian Business & Current Affairs Education))
((interdisciplin* OR multidisciplin* OR cross disciplin*) AND (higher education) AND empirical*) AND ("educational theory" OR "educational studies" OR "educational methods" OR

"didac*") 2000 -2014 **Results: 84 hits**
PsycINFO:
(higher education) AND SU.EXACT("Interdisciplinary Research") AND me.exact("Empirical Study") 2000-2014 **Results: 20 hits**
SCOPUS
TITLE-ABS-KEY((**interdisciplin*** OR **multidisciplin*** OR **crossdisciplin*** OR **transdisciplin***) AND (**higher education** OR **academic*** OR **universit*** OR **academic***) AND (**empiric*** OR **didact*** OR **methodolog***) AND (**learning** OR **teaching**)) AND PUBYEAR > **1999** AND (LIMIT-TO(LANGUAGE, "**English**") OR LIMIT-TO(LANGUAGE, "**German**") OR LIMIT-TO(LANGUAGE, "**French**")) **Results: 336 hits**
Web of Science
TS=((interdisciplin* OR multidisciplin* OR crossdisciplin* OR transdisciplin*) AND (Higher education OR academic* OR universit* OR academic*) AND (empiric* OR didact* OR methodolog*) AND (learning OR teaching))

Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH Timespan=2000-2014

Results: 426 hits

Appendix 3

Table for Initial Reading of Articles

Table for initial reading of articles	
Authors	
Title	
Publisher/Journal	
What type of empirical data is described and used?	
What disciplines/fields/subjects are described?	
What type/name for interdisciplinarity is used?	
What are the main conclusions?	
What is the presented problem?	
What are the presented solutions?	

Table used for the initial reading of the articles to capture the main features of each article

Appendix 4

Codes Used for the Analysis of Articles

Article number	Academic field	Course type	Academic level	Teaching methods	Student role	Examination	Content focus
2		GWC,	UG	TT, WM		PFE	IWS, PS
3	Health	SC,	UG	CBT, WM		FF	PS
7	Hum,		Min, UG,	PBL, TT,	IWS,		
10	Hum		UG, Maj	TT, LB,	GW	WL	PS
11	Hum,	SDS,	UG	WM	PS,		
12	Hum		UG	WL		EBE, FF	IWS, PS
13	Sci	IDP,	DL	CBT, PBL	PBW, PT,	FF	DS, IWS
14	Hum	SAC,	MA	CBT	GW, PBW		IWS, PS
18	Hum	CM,	UG	TT, WL		EBE, PFE	PS, IWS
19	SoSci	SAC,	UG	LB, CBT	GW	EBE, PFE	PS, IWS
20	Hum	GC, CM,	UG	TT	GW	Q, EBE	DS, IWS
21	SoSci, Hum,	SDS,		WM, CBT	GW, PT		IWS
24	Hum, SoSci,	GWC,	UG	TT, PBL,			
27	Sci	SC,	UG	LB, CBT,			
28	Health, Hum	CM,	MA	CoBT,			
30	SoSci	CM,	MA	WM, GW,			

Examples of codes for some of the reviewed articles. Not all categories were applicable for all articles.

Legends: The used codes and the frequency in all the reviewed articles can be seen in the following table

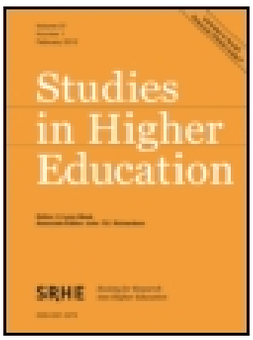
Code	Frequency	Description
CBT	28	Case based teaching
CoBT	12	Community based teaching
DS	25	Disciplinary Skills
EBE	20	Essay Based Exam
FF	14	Formative Feedback
G	1	Graduate
GW	41	Group Work
Health	21	Health
Hum	33	Humanities
IWS	46	Interdisciplinary Working skills
LB	22	Lecture Based
MA	19	Master
Maj	3	Major
Min	3	Minor
OE	13	Oral Exam
PBL	13	Problem based learning

PBW	23	Project based work
PFE	11	Portfolio exam
PS	31	Personal Skills
PT	15	Peer teaching
Q	9	Questionnaire
SCI	31	Science
SDS	6	Staff Development Seminar
SoSci	24	Social Science
TT	22	Team Teaching
UG	36	Under Graduate
WL	11	Web Log
WM	19	Workshop Model

PAPER II

Creating interdisciplinary education within monodisciplinary structures: the art of managing interstitiality

Katrine Lindvig, Catherine Lyall & Laura R. Meagher
Studies in Higher Education



Studies in Higher Education

ISSN: 0307-5079 (Print) 1470-174X (Online) Journal homepage: http://www.tandfonline.com/loi/cshe20

Creating interdisciplinary education within monodisciplinary structures: the art of managing interstitiality

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To cite this article: Katrine Lindvig, Catherine Lyall & Laura R. Meagher (2017): Creating interdisciplinary education within monodisciplinary structures: the art of managing interstitiality, Studies in Higher Education, DOI: 10.1080/03075079.2017.1365358

To link to this article: http://dx.doi.org/10.1080/03075079.2017.1365358

STUDIES IN HIGHER EDUCATION, 2017
https://doi.org/10.1080/03075079.2017.1365358

Routledge
Taylor & Francis Group

Creating interdisciplinary education within monodisciplinary structures: the art of managing interstitiality

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ABSTRACT

The literature on interdisciplinary higher education is influenced by two overall trends: one looks at the institutional level of specially designed interdisciplinary institutions, while the other assesses individual interdisciplinary educational activities. Much less attention is given to the processes of creating interdisciplinary education initiatives within traditional monodisciplinary universities. In this study, we thus explore how interdisciplinary education and teaching emerge and develop within universities that have little or no established infrastructure to support interdisciplinarity. Using qualitative data from a multi-part case study, we examine the development of diverse interdisciplinary educational efforts within a traditional faculty-structured university in order to map the ways in which interdisciplinary educational elements have been created, supported, challenged or even strengthened by pre-existing monodisciplinary structures. Drawing on theories from economics, literature studies and sociology of education, we conclude that creating interdisciplinary education in such settings demands skills that we define as the 'art of managing interstitiality'.

KEYWORDS

Interdisciplinary activities; faculty-structured university; higher education; managing interstitiality; student pathways

Introduction

> [A]ny discussion of interdisciplinarity needs to be related to institutional developments in academia (Moran 2010, 29)

Ever since the OECD conference in 1972 (Apostel 1972) identified five drivers for interdisciplinarity, institutional structures in academia have been recognised as crucial in the development of interdisciplinary research and education. The breadth and depth of the academic field of interdisciplinary education reflects increasing interest in the production of graduates who can move between disciplines (Global Research Council 2016). While the literature touches upon aspects of introducing and implementing interdisciplinarity in single courses, programmes and graduate studies (Davis 1995; Newell 1994; Orillion 2009), when it comes to describing interdisciplinary teaching in an institutional setting, most published literature focuses on universities that were *specifically established* as interdisciplinary institutions, e.g. Roskilde University, Arizona State University, as well as on individual centres, honors colleges and undergraduate programmes that were *specifically designed* to be interdisciplinary (Holley 2009; Mansilla 2006). So far, little attention has been given to the gradual development and implementation of interdisciplinary education within traditionally monodisciplinary universities. In this we refer to most European universities dating back more than a hundred years. Though the university as an institution may take many forms, most long-established (European) universities are still structured according to scientific disciplines and organised into 'faculties' (groupings

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of closely related discipline-based departments). The aim of this study is therefore to understand how interdisciplinary education emerges and develops in association with research, in universities with little or no original infrastructure to support interdisciplinarity. The term *Interdisciplinarity* is in this context used in its widest definition to mean any dialogue or interaction between two or more disciplines (Moran 2010, 14). This paper reports primarily on a longitudinal study of the creation and development of interdisciplinary educational efforts at a traditional European university. It draws on a mapping of interdisciplinary provision in the UK higher education (Lyall et al. 2015) in order to complement these data with a national perspective and thus to provide some broader context regarding the current interdisciplinary landscape.

Through analyses of empirical material collected across five case-projects over the span of three years, we observe the ways in which interdisciplinary activities have developed in the interstices of monodisciplinary structures and how these developments can be interpreted as ways of 'managing interstitiality'. By way of presenting these findings, we draw on theories from the sociology of education (Bernstein 2000), literature studies (de Certeau 1988) and economics (Penrose 2009). It is our belief that this opportunity to investigate the inter-relationships between the dynamics of creating interdisciplinary provision and the context of traditional structures makes it possible for us to offer insights that may contribute to understanding of interdisciplinary provision in European institutions more broadly.

Background: the field of interdisciplinary education

A growing body of literature focuses on the institutional levels of interdisciplinarity, of newly developed interdisciplinary institutions and reform universities (Weingart and Padberg 2014) and monodisciplinary institutions being restructured to cater for interdisciplinary research (Townsend, Pisapia, and Razzaq 2015). This focus is particularly strong in the European literature, however, a certain niche of literature describing larger institutional experiments with interdisciplinary research, education and learning is also present in the American literature (Kezar and Elrod 2012; Kezar and Kinzie 2006; Luckie, Bellon, and Sweeder 2012; Mansilla 2006; Mansilla et al. 2009). Areas where the literature from North America takes the lead are in planning and structuring interdisciplinary undergraduate programmes (Haynes 2002; Henry 2005; Klein 2005; Newell 2008) and the development of interdisciplinary curriculum and assessment tools (Barber, King, and Baxter Magolda 2013; Mansilla et al. 2009; Mansilla and Duraisingh 2007; Nikitina 2006) as well as specially designed entry courses (Orillion 2009).

The areas mentioned above encompass a substantial part of the literature, yet the most extensive body of literature focuses on case studies of single courses, often spanning two or more disciplines and crossing the divide between natural and life sciences and social science and humanities (McKendrick and Mooney 2001; Simmenroth-Nayda, Alt-Epping, and Gágyor 2011; Stern et al. 2008; Tra and Evans 2010) to name a few. Though the literature on interdisciplinary higher education has grown substantially during the past decades, published empirical studies on local initiatives towards implementing interdisciplinary elements in traditional higher education institutions are still scarce (Jacob 2015; Spelt et al. 2009; Townsend, Pisapia, and Razzaq 2015). This lacuna does not reflect the reality of what is currently happening in the higher education sector. Interdisciplinary education activities are occurring within the walls of even very traditional and monodisciplinary universities and come in all sorts, shapes and sizes, as confirmed by Lyall et al. (2015). The aim of this study is to add new rich empirical detail to this broad landscape of institutional change.

Methodology

Setting

The University of Copenhagen dates back to 1479 and is the oldest university in Denmark. The university currently has six faculties (Science, Health, Humanities, Social Science, Law and Theology) and

has, in line with the aforementioned traditional universities, developed as a research-intensive university with an organisational structure primarily based on disciplines and faculties. Despite mergers with other universities (in 2007), a reorganisation of four faculties into two (in 2011) and continuous movement towards the creation of larger departments, it was not until a new 'Strategy 2016' was launched in 2012 that the university explicitly put interdisciplinarity on the agenda.

As part of this strategy, The University of Copenhagen in 2013 set aside 64 million Euros and created the 'Excellence Programme for Interdisciplinary Research', awarding grants to 18 internal research projects (hereafter the '2016-projects') spanning across faculties and disciplines and focusing on themes such as obesity, climate change and ageing. The 2016-projects run until the end of 2017 and were all required to create educational elements, such as undergraduate courses, full course programmes or summer schools, based on their research. These activities were to be designed and implemented within the existing structure of a three-year bachelor's degree, a two-year master's degree and a three-year PhD.

With this requirement, the 2016-projects have created a perfect opportunity to follow interdisciplinary education in the making and to explore the processes and negotiations involved in creating interdisciplinary education.

Data collection

In order to follow the actual processes of developing and embedding educational elements, we have tracked the progression of the overall Excellence Programme and the eighteen 2016-projects (see Table 1 for details on collected empirical material). Simultaneously, 5 out of these 18 projects were selected for an in-depth case study, based on the criteria of the cases representing the broadest diversity possible (Flyvbjerg 2006; Seawright and Gerring 2008). The five cases (hereafter 'case-projects') vary in subject, size, departmental affiliation as well as ambition in terms of the volume and amount of educational elements produced.

In all five case-projects, the first author was contacted whenever new interdisciplinary educational activities were in the pipeline or taking place and held ongoing meetings and conducted interviews with the faculty and students connected to the case-projects. In studying the emergence and creation of the educational elements, ethnographic methods have been used (Marcus 1995; Willis 2000), consisting of participatory observation, focus group interviews with project leaders, PhD- and master's students and educational planners connected to the projects, along with analyses of documents and correspondence (see Table 1 for details).

The collected documents have provided information on the planning, administration and implementation of each educational activity and were furthermore used to inform and support the development of guides for observations and semi-structured interviews. Observations of teaching and meetings were recorded in logs and the interviews were transcribed verbatim. The rationale for observing the planning meetings, teaching and interviewing planners, teachers as well as students was to not only document the actual activities but also to understand the process and the perceived outcomes of these activities, as seen from the perspectives of the students and faculty.

While all of the data inform our conclusions, data at PhD level is only included when the PhD students have either taught courses or participated in PhD courses and summer schools. The PhD programmes as entire interdisciplinary activities will be discussed in another paper.

As stated earlier, the five selected case-projects belong to a group of 18 research projects that were all required under the terms of their funding to develop interdisciplinary educational elements at the University of Copenhagen. To add strength and nuance to our findings, we include a comparison of intended and realised educational elements from all eighteen 2016-projects.

Furthermore, although we believe that the findings from this study mirror the reality of many traditionally monodisciplinary universities (at least in Europe), we recognise that the opportunity we have seized for studying the development and embedding of interdisciplinary educational elements may be distinctive. There may also be limitations to our research design: activities may have been

Table 1. Collected data from the 2016-projects and five case-projects.

Level	Description	Case 1	Case 2	Case 3	Case 4	Case 5	Total
Master level	**Interviews** conducted as: – Single (S) – Focus group (FG)	11 Students 3 interviews (FG)	4 Students 2 interviews (FG)	4 Students 1 interview (FG)	2 Students 2 interviews (S)	2 Students 1 interview (FG)	23 Students 9 interviews
		5 Teachers 3 course-planners	3 Teachers/course-planners	2 Teachers /course-planners	2 Teachers 2 course-planners	3 Teachers	18 Teachers 18 interviews
	Documents	Material for 1 MA elective course and 2 summer school courses	Material for 2 MA elective courses and research apprenticeships	Material for 1 MA elective course	Material for 2 MA elective courses and student-driven, voluntary group sessions	Material for 2 MA elective courses	Material from 8 MA elective courses, 2 summer school courses, research apprenticeships and student sessions
PhD level	**Interviews** conducted as: – Single (S) – Focus group (FG)	9 Students 4 interviews (S = 1, FG = 3)	3 Students 2 interviews (S = 1, FG = 1)	5 Students 3 interviews (S = 2, FG = 1)	3 Students 3 interviews (S)	4 Students 1 interview (FG)	24 PhD students 13 interviews
Management level	**Interviews**	1 Project leader 1 educational manager (interviewed twice)	1 Project leader 1 project manager (interviewed twice)	1 Project leader	1 Project leader (interviewed twice) 1 project manager (interviewed twice)	1 Project leader 1 Project manager	13 interviews
	Documents	Written sections on educational elements from 18 research applications and midterm evaluations, these 5 cases included. The access to and use of the written sections were approved by the project PIs and provided by the university research section, led by the Pro-Rector of research					
All levels	**Participatory observation**	Classroom observation Meetings in educational planning group	Classroom observation Workshop for young researchers	Meetings in educational planning group Young Investigator network meeting	–	Annual research meeting in project	

overlooked, details missed and viewpoints of results and barriers are always personal and subjective. In particular, the rather heterogenous nature of our sample – spanning very different research collaborations and a multiplicity of educational activities – made the imposition of a highly systematic data collection process somewhat challenging. Also, as these projects only have a lifespan of three to five years, there are obvious limits in terms of developing educational elements. To complement our findings, we draw on a study of interdisciplinary provision in the UK higher education (Lyall et al., 2015). Besides a literature review of interdisciplinary provision, that study maps the scale and type of current provision that has developed within the UK and identifies obstacles, plans and trends for the future. By drawing on this study, we hope to be able to highlight the findings and conclusions that relate to a broader European higher education context, as well as any that may be distinctively local to the University of Copenhagen or a Danish context.

In the following section, we will provide an overview of the activities of the eighteen 2016-projects and will outline in some detail the educational elements created by the five selected case-projects, before moving on to the discussion.

Findings

The overview in Table 2 is created by comparing the initial funded applications from the eighteen 2016-projects with their midterm evaluations. Though the projects continue to run until the end of 2017, the midterm evaluations provide overviews of the projects, their progress and the anticipated results of the entire grant period. The first column describes the different activities that have been mentioned in the applications across the projects. The second and third columns describe the number of projects that have planned and realised the various activities. The last two columns describe the total number of activities respectively intended and carried out across the eighteen 2016-projects.

When comparing the 18 project applications with their midterm evaluations, there are several things worth noting.

The first column of the table lists all of the activities that were mentioned and described in either the 2016-project applications or evaluations or both. Out of the various activities listed, only a few of the activities were actually planned by more than a few of the 2016-projects. Whereas elective

Table 2. Overview of planned and realised activities from the eighteen 2016-projects.

Activities	Total number of projects (out of 18) that planned the activities	Total number of projects (out of 18) that realised the activities	Total number of intended activities across projects	Total number of realised activities across projects
Master elective course	13	13	14	38
Master programme	3	2	3	2
Bachelor elective course	6	4	7	6
Bachelor programme	0	1	0	1
Summer school	8	6	8	10
PhD course	10	6	13	16
Journal club	1	3	1	3
PhD student	7	17	43	189
Master thesis	7	13	55	130
Bachelor thesis	4	10	66	67
Online course	1	1	1	1
Young investigators network	3	3	2	3
Workshop	1	3	1	5
PhD programme	1	1	1	1

courses, summer schools and PhD courses were frequently planned, other activities at bachelor's level, programmes and in alternative formats (e.g. workshops, online courses and journal clubs) were not. One explanation for this could be the way the university is structured and the way various educational activities are awarded and credited, which impede the creation of activities at bachelor's level.

The Danish bachelor's degree in general is a fixed monodisciplinary package with very few optional elective courses. This fixed structure contrasts strongly with, for example, the American system with its emphasis on 'liberal arts' but is likely to reflect the nature of many if not most European institutions. A Danish bachelor's degree takes three years of study, with six set modules, finished by an individual written assignment during the third year. Each module consists of courses that in total add up to 30 points in the European Credit Transfer System (ECTS). In order to obtain a bachelor's degree, a total of 180 ECTS points is required.

Following the bachelor's degree, students can choose between various master's degrees, so long as the bachelor's degree is compatible with the requirements for entering the master's programme. A master's degree requires two years of study and a total of 120 ECTS points. These points are obtained partly through elective courses, partly through the master's thesis, written in the final year of study. In contrast to other European countries, an academic bachelor's degree is usually not sufficient to secure a job in Denmark, which means that the large majority (85%)[1] of Danish University students finish their studies with a master's degree, after a total of five post-secondary years (Danske Universiteter 2014).

This structure leaves the 2016-projects with a limited set of options: elective courses, primarily at master's level, summer schools and PhD courses are easily fitted in to the existing structure. Bachelor's courses are possible to create, however, it is difficult to find a host department for them and they tend to have a smaller target group, thus attracting fewer students. As one Project leader from a case-project puts it:

> Where I come from, you do not have elective courses – and in the other programmes I know of, the widest freedom of choice is at the master's level so that is simply where the main 'customer base' is (…) whenever I think of elective courses, I think of elective courses at master's level. (Project Leader, Case 1)

The rather locked structure could be assumed to account for the modest or realistic expectations in the 2016-projects' plans, and could be the reason why the courses at bachelor and the programmes at master's level weren't realised as hoped. Meanwhile, these constraints could also explain the high level of students enrolled in the projects: in the final and total numbers of master's- and PhD students there was an increase of respectively two and four times as many as projected in the research applications. Writing a master's thesis in relation to a large interdisciplinary research project is a way for the students to specialise in an area of interest, despite the locked structures of their study programme. Furthermore, from the perspective of the 2016-projects teams, activities such as courses and summer schools require a lot of planning and time away from the research projects, whereas students at master's and PhD level bring money, workforce and publications hence direct added value to the projects. In light of this, the increased number of students in the projects makes sense.

In addition to the activities mentioned above, there were also activities created that were neither anticipated nor documented formally in the applications and evaluations. These activities included research internships, teaching-based research and what one of the case-projects identified as 'hang-around students', which we describe later. These activities were not reported or documented through any of the official channels, and only became apparent to us through an ethnographic study of our five case-projects. As these activities came to our attention through observations and interviews, they were further explored through follow-up interviews with students and faculty involved in the activities. These additional activities were mapped throughout the study, however, with the obvious limitations of activities not being reported by the interviewees, hence not brought to our attention.

In the following section, we will elaborate on these findings in addition to the activities cited in the official reports from the five case-projects.

Interdisciplinary educational activities in five selected case-projects

The activities that were not only planned but also realised in the five case-projects can roughly be divided into three categories: elective courses at master's level, elective courses at PhD level and student-driven activities at all levels.

Master's level courses

Six elective master's courses were produced by the cases in the period from 2014 to 2017. Though the course themes varied, the course set-ups were quite similar: all of the courses were intended to be interdisciplinary in content and structure; they all had a mixed group of students, often spanning the faculty but also sometimes including students from other faculties and universities. Finally, the researchers and PhD students connected with the case-projects accounted for most of the teaching.

While there were many overlaps in terms of set up, the motivation behind creating the courses varied. For one of the courses, offered at the Faculty of Humanities, the motivation was to link the interdisciplinary research of the case-project closer to the teaching at the faculty and to the students:

> To us it was important that it wasn't a research project completely detached from the teaching at the faculty. We have to integrate the external research more in the teaching than it has previously been done – and of course it being an interdisciplinary project, it made sense to do it through an interdisciplinary course. So this is something we have planned from the beginning. (Interview, Assistant Professor, Case 2)

In other cases, the motivation was for the faculty to teach about something they already conducted research on and at the same time fill in a slot available among the fixed number of elective courses offered at the department:

> So we were given permission to set up this course because it was something that was very much related to what we worked with – also it was a great way to get to discuss some of the issues at stake in our research field. So it was a combination of an open slot in the module and us shoving the way in and it has been great. (Interview, PhD student, Case 3)

A third argument for creating elective courses was to recruit students and thereby make use of the students' skills within the very new research area. One way was to use the courses as a way to create interest among students, in order to encourage some students to subsequently write their master's or bachelor's theses, applying data created in, on and for the case-project. Another way was to use the course itself as a space for generating collaboration across hierarchical divides:

> So the idea is for the course to be a place where students and researchers meet and where the students can engage with and join the ongoing research projects but of course also take initiatives (themselves) to set up their own research projects that then the established researchers can join. (Interview, Associate Professor, Case 4)

None of these courses ran more than once in their original design. In one of the cases, the course was intended to be embedded as a recurring course, but was instead cancelled before the second round due to lack of participants. One of the explanations for this was the lack of visibility in the course catalogue, where the course was only visible to students from the section, where it was offered, making it difficult to attract enough students. Another course was, despite great student reviews, only offered once due to lack of qualified staff available to teach. A third course was at first only offered in one subject (but open to students from outside) and became so popular that they decided to change the course and offer it as a new course across the faculty. Yet another course was changed from an elective course spanning 14 weeks during fall, into a 2-week summer school, that was then run twice. The reasons for this were partly the administrative barriers in terms of ECTS points, assessment, grading and transfer between faculties, which did not represent the same problems in the summer school format; partly an extra pot of money given to the development of summer schools at the university. Thus a common influence affecting the course activities lay in the barriers that the monodisciplinary structures create:

> It is definitely in the cards that the next time we run something like this, it has to be anchored across the disciplines and this is also something we are discussing with our institutions, to put it that way. We would like them to somehow deal with this, so that we do not meet administrative and other barriers in relation to the course. Because you do meet barriers – not that you can't get around them, however, you do meet them. (Interview, Associate Professor, Case 4)

PhD-level activities

All of the five case-projects have produced courses and summer schools aimed at PhD students. Overall, the PhD elective courses and summer schools appear to have run more smoothly than the activities at lower levels. As an example, one of the PhD courses began as a joint collaboration between the Faculty of Law and a local biobank; it ran twice and was then transformed into a European PhD course, a Massive Open Online Course (MOOCs) and a new international master's programme to be launched within the next couple of years. This was not due to the administrative structures but a matter of current supply and demand:

> We have here a template for how you could do it. But obviously we can't offer this again. We won't attract any of the students we already had so we have to change it in that sense. And that is what we are going to. (Interview, Associate Professor, Case 3)

Some of the case-projects have managed to create and run summer schools repeatedly during the whole project period, using it as a venue for teaching upcoming researchers within their field and presenting their research.

One project has successfully created a new interdisciplinary PhD programme at the faculty level, in order to align with new research entities, with the argument that:

> The current PhD school, exclusively based on department programs, is insufficient to meet the demands for interdisciplinary PhD students in the years to come. Substantial consultation with the Faculty has led to a new PhD program in Social Science, which will be operational for the new PhD students to be hired in the embedded research center being established at the Faculty of Social Sciences. (Midterm evaluation, Case 4)

Student-driven activities

Even though activities in this category did not appear in the project applications from the case-projects, it has proven to be a large category. The case-projects have all had bachelor's and master's students assigned to the projects, but, perhaps surprisingly, additional students participated, as well. While a large number of thesis-writing students were anticipated, the large group of students participating despite having no official affiliation to the case-projects (so-called 'hang-around' students) was not. In one of the case-projects, for example, students at bachelor and master's level have voluntarily used their spare time to join research meetings, develop digital codes and new software:

> And then they have just been interested in the project and some of them have then later on become PhD students here and there but you know, not financed by us. And some of them are just – some of them are still master's students, some of them we have tried to pay salary to, but they haven't accepted it, they have just sat and worked – so we have two students that have just been sitting and coding stuff for us. One of them is now writing his master's thesis based on that data. (Interview, Project Leader, Case 4)

Self-motivated students have also added to the research by writing extra assignments about the project in unrelated courses, and have created student collectives working on their own with data from the case-project:

> Back then, I was working on my own project, it was my bachelor thesis – then I suddenly realised how much greater it could be, if my data collection could get access to this large project (…) and then this idea really didn't go any further but I think the project manager thought it was a fun idea, and so ever since then I have just been connected to the project (…). (Interview, Master's student, Case 4)

During the project period, the case-projects have also created three- and six-months research internships (driven by student demands), where master's students have participated as interns in the case-

projects and have gained ECTS credits in return. Prior to the project period, students were only able to take internships and receive ECTS credits outside of the university. To the students interviewed, this has given them something completely different:

> And to be part of a place, where you get a connection to something that is just everywhere, cutting edge is for a historian at least, pretty different, I think. If you are dealing with a massive, interdisciplinary research project, then no matter what the subject is it will broaden your horizon and get you closer to the bigger societal challenges. (Interview, Master's student, Case 2)

Discussion and implications

Comparisons with interdisciplinary provision in the UK

From the perspective of pushing towards institutionalisation of more interdisciplinary education, the findings presented above from the Danish case can appear quite discouraging. The activities developed and documented in evaluations and applications only entail a few larger programmes and are mainly set up as one-off elective courses with no subsequent embedding. The courses are not developed systematically and are very much dependent on the interest and engagement of individual faculty members in addition to volunteering students with no formalised attachment.

However, this accords with the findings from our previous study of the UK situation with regard to interdisciplinary learning and teaching provision (Lyall et al. 2015). Here we found that, although interdisciplinary education is a live topic in the UK, with the majority of survey respondents reporting trends towards more interdisciplinary undergraduate and postgraduate teaching, a significant proportion believed that the level is unchanged and university teachers were more likely to report this increase than university leaders.

There were also different views on what was driving this. While university leaders reported that this increase was in response to the professional needs of graduates seeking employment, university teachers were more likely to attribute it to the individual research interests of academics in alignment with concerns about complex global societal issues (such as climate change, ageing). Individuals who develop interdisciplinary teaching provision were seen as pioneering champions often working against the status quo. Moreover, as with the Danish case, we could discern no evident trends or typologies in terms of the form that this educational provision took: instead we identified a range of sometimes transient activities occurring at different scales – at the level of one-off workshops, single course modules or units or, sometimes, full degree programmes.

Examples ranged from: 'AcrossRCA', a response to student demand in the form of a special week-long extracurricular programme of cross-disciplinary working in innovative projects at the Royal College of Art, to an undergraduate module first piloted with the 'Edinburgh Living Lab' initiative to combine interdisciplinarity with real-world problem solving and then developed into an approved elective, all the way through to an explicitly interdisciplinary undergraduate degree programme for an Arts and Sciences (BaSc) degree at University College London. Evidence from this study demonstrated the important role of committed 'academic entrepreneurs' and the challenges they faced in navigating typical university structures, even when such innovations were sanctioned by senior institutional leaders. As one interviewee put it:

> It takes a long time and we can be conservative as institutions, but it is important to keep listening and put in significant management grind to come up with something that satisfies both students and academics. (Interviewee, Case study 1)

On the one hand our current findings confirm that the dominant mode of knowledge production is still one of disciplines controlling content, pedagogy and the organisation of higher learning (Henry 2005, 4); on the other hand, the findings also point towards what Klein has called the *mission for insurgency* (Klein 2010, 123) where the aim of interdisciplinarity may be precisely to unsettle conventional disciplinary practices. While agreeing with Henry and Klein on this, we do, nonetheless, also consider

the findings to be examples of another practice or tendency, which has to do with relations between strong and weak external *framing* (Bernstein 2000), *strategy* and *tactics* (de Certeau 1988). We term this practice the 'art of managing interstitiality'.

External framing, strategy and tactics

In Bernstein's terminology, framing is about *who* controls *what*. Framing can be either internal or external and regulates relations within a context. Furthermore, it refers to relations between transmitters and acquirers of knowledge in an educational context (Bernstein 2000, 14). In our University of Copenhagen setting, we understand the external framing to be the administrative structures at the university, regulating the various types of educational activities it offers.

The monodisciplinary higher education structures, especially in the Danish setting (with its fixed programmes at bachelor's level and only a few elective options at master's level) are, in Bernstein's terms, defined by a strong external framing. The transmitter (the university administration and management) has explicit control over timetabling, sequence, pacing and entry criteria for courses and programmes, and the acquirer has little say in this. In our study, this is illustrated by the lack of interdisciplinary programmes and courses developed at bachelor's level and by the type of activities developed at master's level. Because the framing is so strong, it is simply not possible for the acquirers (in this case the 2016-projects) to influence or change the overall educational structure in these settings. Nonetheless, our study shows areas with weak framing, in which we identify 'interstices', where it is possible to create interdisciplinary activities. With this term, we refer to spaces that intervene between closely spaced things, to gaps or breaks in something generally continuous ('"Interstice." Merriam-Webster.com.,' 2017). PhD courses and summer schools are, for example, made possible because they are located in postgraduate study levels, where the external framing is weaker than at bachelor's level. These activities are not required to fit in a certain module, they can be made to fit the needed ECTS points and they are not limited to students from just one section, discipline or faculty.

According to Bernstein, the European subject-based higher education system in general carries a much stronger framing compared with the American course-based liberal arts tradition (Bernstein 1975, 62). While this strong framing certainly limits the embedding of interdisciplinary courses and programmes, our study is also evidence of ways that the 2016-projects and the students have succeeded in weakening the framings. This is done at various levels: when one of the projects succeeds in setting up a new PhD programme, cutting across the faculty, this is a way of weakening the external framing still further and giving more power to the project and the students involved. If there is an entry to a PhD programme from students from various disciplines, these students do not have to limit their master's thesis to only focus on one discipline, as was previously the case:

> S1: (…) you know I am convinced that you almost have to dismantle the faculties and merge the shit because these divides you have created are artificial and there are no reasons for keeping them, you know?
>
> S2: It is so stupid to try and limit us. (Interview, Master's students, Case 3)

One of the elective courses mentioned in the findings was offered at the Faculty of Humanities but open to students from all faculties. While the course received very positive student evaluations, there were issues with the access and assessment of students from the other faculties. The external examiner graded the science students lower, thus making it less attractive for future science students to cross the faculty lines. In the quote above, the students criticise the divides that they call artificial and call for a closer collaboration and connection between the different areas. Despite the problems with assessment and the low supply of interdisciplinary elective courses, the course has encouraged them to take more interdisciplinary courses. Such efforts can themselves set precedents or illustrate for others the feasibility of trying such things. As one of the students puts it:

> No matter the subject, no matter how small the selection of courses there is at the master's, I am sure I can tweak it into something that I want – if they won't specialize me, then I sure as hell will go ahead and do it myself. (Interview, Master's student, Case 3)

The way the 2016-projects and the students weaken the administrative and monodisciplinary framing, though they clearly are the ones with the least visible power, points towards differences in strategy and tactics, as described by de Certeau (1988). In his work, he applies the city and the pedestrians as a metaphor for the difference between static and fluid power. The buildings in a city constitute the visible power: they are part of a planning strategy; they control what routes are possible; they are placed according to the logic of the official city planners and they are static, thus cannot be overlooked or moved (de Certeau 1988, 37). As the opposite, the pedestrians are not static: they move on territory planned and owned by others and can therefore not apply fixed strategies. They operate in isolated actions, employing tactics and take advantage of opportunities here and now. What they win, they cannot keep. In short, a tactic is the art of the weak (de Certeau 1988).

Translated to our study, the university and faculty administration represent the buildings in the city; they create the university infrastructure and they decide on the routes available to the students and the 2016-projects. The 2016-projects take advantage of the opportunities at hand and create courses that may not last in the established structure, though they still form and affect the appearance of the university, just as the pedestrians do in the city:

> To us the students are super important. No doubt about it. When we meet in the steering committee, we make fun of it but of course we all know that in reality we are completely dependent on them, well not only are we depending on them, when it comes to the research project, they are the ones deeply entrenched in the practical data work. So in that sense I think we all have a pretty strong idea of them playing the key roles in this. (Interview, Associate Professor, Case 4)

As stated in this quote, the students play a vital role in the case-projects, and in this context they do it through the elective courses they attend. In this way, they have helped push forward recognition of the need for courses like these in the programmes offered by the faculty. As in de Certeau's description of pedestrians in the city, the students change the structures meanwhile creating them (de Certeau 1988, 93). In our study, there are also other examples of ways the students change the structures by their 'walking about': in setting up student collectives, participating in projects on a volunteer basis or by taking on research apprenticeships in the case-projects:

> In that sense, the project, or the internship has been an eye-opener to this and to the chance of becoming a better researcher, for instance. But also just in your view of the whole world, I think – to get that wider perspective. That thing about meeting someone over at another faculty is really an eye-opener. (Interview, Master's student, Case 2)

The experiences the students get from taking part in these activities affect the future path they choose. Even though the courses are not embedded in the lasting structures, they still add to the students' experiences of the university. As a result, they navigate differently through the interstices, thereby playing a vital role in creating interdisciplinary activities in structures that were not originally built for it.

Through our findings and discussion, we have attempted to illustrate how interdisciplinary education is created within monodisciplinary university structures. The processes we investigated underscore the difficulties of embedding interdisciplinary education in monodisciplinary structures when the structural framing is strong, and in contrast the power of particular efforts – and not least the students – is weak or at least elusive. In the existing literature, this situation is seen to point towards interdisciplinary education being expensive, fragile and easy to cut in times of financial instability (Augsburg and Henry 2009; Henry 2005; Klein 2010). Looking at it from another perspective, it is, however, also possible to see these traits as the exact reasons for protecting or continuing the growth of interdisciplinary education in these structures; as way of making productive use of the interstices in the system:

> Essentially the interstices are created because there is a limit on the rate of expansion of every firm, including the larger ones; the nature of the interstices is determined by the kind of activity in which the larger firms find their most profitable opportunities and in which they specialize, leaving other opportunities open. (Penrose 2009, 196)

If the established monodisciplinary programmes and the faculty structures are seen as the larger firms in this quote from Penrose, the interstices occur as the momentary gaps in the study programmes, such as the space available for hang-around students in the case-projects and the connections between case-projects and interdisciplinary elective courses. In other words, the interdisciplinary activities created by the case-projects point towards the interstices in the monodisciplinary structures. In our study, the interdisciplinary elective courses might not happen more than once, nevertheless, they fill a gap that would otherwise leave the students with fewer opportunities to specialise in novel ways tailored to their interests. Similar to pedestrians creating new paths by crossing streets and grounds where they weren't supposed to travel, thus over time changing the original infrastructure in the city, these one-off courses open the door to other such efforts, by providing precedents, demonstrating possibilities, helping administrators adjust to working with such efforts, etc. While the Danish subject structure has significant reach, there are nonetheless interstices remaining that it is possible to 'manage' (e.g. fill with innovative efforts such as specialised, research-based courses or informal involvement of self-motivated students) in a way that complements existing, more conventional activities.

This leads us to suggest that there are further insights to be gained from this study. The fact that so many activities were left unevaluated – and thus unvalued – by the institution, in contrast to the enthusiasm expressed by both students and project managers, points to a need for further research into the dynamics of creating novel educational activities within structures that from the outset were not made to measure or reward these activities. A starting point for initiating future similar programmes would be to discuss new ways of recognising, documenting and evaluating educational activities, thus increasing awareness of the full range of different sorts of value that can be added beyond those conventionally anticipated. This could lead to rethinking the definitions of 'productive' and 'efficient' higher education.

Conclusion

Our study of interdisciplinary educational activities created in a monodisciplinary Danish setting reveals a range of efforts, rather than any one pervasive approach, echoing findings from Lyall et al. (2015) UK study. We found that the activities created lie in the interstices between the strong monodisciplinary framings that are set up by the traditional university structure and supported by the Danish subject-based tradition. The interdisciplinary activities thrive at the more flexible upper levels of higher education, where more interstices can be found – as elective courses at master's level, PhD courses crossing the faculties and as student-run activities in interdisciplinary research projects. These activities are seldom institutionalised but occur where gaps open up in the course programme; whenever a faculty member takes on an entrepreneurial role or whenever students follow their own academic ambitions instead of the official curriculum assigned to them. While these activities are given little space in official reports and learning accreditations, they are nonetheless shaping the university landscape by revealing otherwise hidden interstices and thereby creating stronger connections between research projects, students and teaching structures.

In this perspective, creating interdisciplinary education in monodisciplinary settings is not a case of pitting monodisciplinarity against interdisciplinarity; it is about taking advantage of the full landscape, the structures and the spaces between them, in order to increase the total education outcome for the university management and administration, as well as for the researchers and students. In other words, it is the art of managing interstitiality.

Note

1. Of those completing a bachelor's degree in 2012 at a Danish university, 85% were enrolled in a master's programme one year later.

Acknowledgements

The study behind this paper was conducted as part of the project 'Interdisciplinary Education' at the University of Copenhagen. We gratefully acknowledge the assistance of the members of the project and of the individual respondents who contributed to the research. We would also like to thank the Augustinus Foundation, the Knud Hoejgaard Foundation and the Institute for Advanced Studies in the Humanities at University of Edinburgh for the support that made the writing of the paper possible.

Disclosure statement

No potential conflict of interest was reported by the authors.

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PAPER III

‘It’s really very schizophrenic’: interdisciplinarity and the implied PhD student

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Journal of Higher Education Research & Development

‘It’s Really Very Schizophrenic’: Interdisciplinarity and the Implied PhD Student

Abstract

While the literature concerning doctoral students has looked at institutional setup and socialization of students across disciplinary boundaries, so far, little attention has been given to what constitutes the doctoral student in the intersections between strategic interdisciplinary research projects and monodisciplinary institutional structures, which is the aim of this paper. The study is based on interviews with 32 PhD students and Principal Investigators affiliated with five research-projects in the Excellence Programme for Interdisciplinary Research at University of Copenhagen, Denmark. In analysing this empirical material, the analytical concept of the ‘implied student’ has worked as a sensitizing concept, highlighting the expectations of PhD students, Principal Investigators, the institutions, the educational system, and the encounter between them. In the interviews, the PhD students emphasise the conundrum of having to fit into a confined disciplinary role, while simultaneously being expected to cross boundaries and deliver on predefined goals in the interdisciplinary research-projects. The findings show students that cope with these expectations by limiting the scope for improvisation and experimentation; in other words, suppressing education’s ‘other’. The implied PhD student in this setting, I argue, is thus neither monodisciplinary nor interdisciplinary – but disciplined. This calls for greater attention to be paid to the accumulation of expectations heaped upon such PhD students and how this affect the education of the future generation of researchers.

Introduction

> "All these expectations assigned to the PhD level is also part of what makes PhD students such an odd size – because you expect them to equally lift the interdisciplinarity and to act like school children. Meanwhile, it is a research-education so they also have to be extremely talented and do all sorts of things. It's really very schizophrenic." (Project manager)

In 2013, the University of Copenhagen (UCPH) introduced the Excellence Programme for Interdisciplinary Research, awarding 18 research projects a total of 64 million Euros. The aim was to boost interdisciplinary research at the university, thereby strategically equipping the university for the upcoming Horizon2020 calls for interdisciplinary research. From across the university, more than 200 PhD students were affiliated with the 18 projects. These students thus became part of interdisciplinary research projects, while simultaneously enrolled at a traditional, European, monodisciplinary faculty-structured university.

In the quote above, a project manager from one of the research projects addresses various expectations assigned to the PhD students. These expectations originate among others from the management in the research projects, the management at faculty level and at the Graduate School level. Reflections on PhD students, their role and responsibilities in the project, such as the above, took up most of the hour long interview with the project manager. However, the interview-questions initiating these reflections were not related to the PhD students at all, but were instead focusing on the interdisciplinary aspects of the project. This was a recurring experience spanning across interviews with managers as well as students: whenever questions on interdisciplinarity were posed, e.g. asking students and Primary Investigators (hereafter PIs and co-PIs) to describe interdisciplinarity or interdisciplinary activities, the response and reflections would move towards other issues.

The study is based on qualitative interviews with PIs and PhD students, from five case projects, which are selected from the total of 18 projects in the Excellence Programme for Interdisciplinary Research[1] (hereafter the Excellence Programme) at UCPH. The interviews were part of a larger field study with the aim of exploring linkages between interdisciplinary research and education. Although we initially set out to explore the epistemic nature of interdisciplinary research in these interviews, time and again the focus of

[1] http://research.ku.dk/strengths/excellence-programmes/

the interviews hinged on the expectations related to the PhD students affiliated with the interdisciplinary research projects. This is the setting and background of this paper.

Conceptualising the PhD

One of the pressing issues in the literature on higher education is how to navigate through the many conceptualisations of the doctoral degree: what is a doctoral degree (Poole, 2015; Trafford & Leshem, 2009), what does it entail (Durette, Fournier, & Lafon, 2016), (how) can it be defined and captured (Wellington, 2013), what are the variations of the doctoral degree internationally and how has it developed (McAlpine & Åkerlind, 2010; Park, 2007). Furthermore, what are the implications of a concept covering so many different constellations and what would it mean to have just one global doctoral degree format? (Nerad & Heggelund, 2008).

When looking at types of doctoral students, the monodisciplinary 'traditional Humboldtian master–apprentice model' (Kehm in Nerad & Heggelund, 2008, pp. 19–35) and the professional doctorate (Wellington & Sikes, 2006) represent the poles of the spectrum of models, with a variety of 'new types' falling in between (Park, 2007). During the last decades, a new group of doctoral students has arisen within this spectrum. These are students involved in interdisciplinary research, either at an interdisciplinary home institution (i.e. Arizona State, MIT) or as part of an interdisciplinary research project, funded by large interdisciplinary research initiatives (i.e. NSF, Horizon2020). A particular focus in the studies of these students has been the risk and uncertainty involved in obtaining an interdisciplinary degree (Rhoten & Parker, 2004; Rhoten & Pfirman, 2007). The risks encompass the lack of a clear monodisciplinary profile to secure tenure (Acker & Haque, 2015; Acker & Webber, 2017; Lyall et al., 2011), lack of qualifications and socialization to take on interdisciplinary research (Felt, Igelsböck, Schikowitz, & Völker, 2013; Gardner, 2008, 2009; Golde, 1999), the blurry expectations from multiple supervisors (Guerin, Green, & Bastalich, 2011), the risk of lacking specialised training (Hackett & Rhoten, 2011) and the frustrations and work involved in becoming the boundary spanner of the research group (Blackmore & Nesbitt, 2008; Lyall et al., 2011, pp. 105–106).

While the debate about "doctorateness" in a monodisciplinary context has primarily focused on issues showcased in the thesis and at the final examination (Poole, 2015; Wellington, 2013), the literature concerning *interdisciplinary* doctoral students has instead looked at the institutional setup and socialization of students across disciplinary boundaries (Baker &

Lattuca, 2010; Gardner, Jansujwicz, Hutchins, Cline, & Levesque, 2014; Golde, 1999; Lattuca, 2002; Lyall & Meagher, 2012; Mansilla, 2006). Furthermore, the literature on interdisciplinary doctoral students and programmes has, with a few exceptions (e.g. Geschwind & Melin, 2016), been based on cases within the UK or outside Europe, where students have been enrolled in interdisciplinary programmes in interdisciplinary structures (Holley, 2017), primarily within the natural and life sciences (Carney, 2011). So far, little attention has been given to what constitutes the doctoral student in the intersections between interdisciplinary research projects and monodisciplinary institutional structures. This is the purpose of this paper. In this, asking: What is the implied PhD student of interdisciplinary research projects within monodisciplinary structures and how are the expectations of the PhD students affecting the PhD degree?

Study context

UCPH dates back to 1479 and is the oldest university in Denmark. The university currently has six faculties (Science, Health, Humanities, Social Science, Law and Theology) and has developed as a research-intensive university with an organisational structure primarily based on disciplines and faculties. Despite previous mergers with other universities and reorganisations of faculties, it was not until a new 'Strategy 2016' was launched in 2012 that the university explicitly put interdisciplinarity on the agenda. As part of this strategy, UCPH in 2013 set aside 64 million Euros and created the 'Excellence Programme for Interdisciplinary Research', awarding grants to 18 internal research projects spanning across faculties and disciplines and focusing on themes such as big data, climate change, geo-genetics and bio-banking. In the call for applications (University of Copenhagen, 2012), emphasis was put on the 'contribution to research such as PhD and postdoctoral fellowships and ensuring the positive development of research environments'. For the research-projects there was thus a specific incentive to recruit PhD students to the projects, and around 200 PhD students were affiliated to the 18 projects. As the research funding was distributed to the PIs and then on to the departments affiliated to the individual researchers of the projects, the PhD students were enrolled in the faculty-based Graduate Schools and became part of the home department's PhD programme. These PhD students were thus legally enrolled on equal terms as PhD students on traditional open studentships.

The PhD programme at UCPH is regulated by the 'General rules and guidelines for the PhD programme at the University of Copenhagen' (2014), based on the Danish framework for higher education (2009), deriving from

the European qualifications framework for higher education (Bologna Working Group, 2005). These international guidelines define the PhD student as becoming an independent researcher with development and research obligations, and as a student and research apprentice. In a Danish setting, the most common PhD programme is equivalent to 180 ECTS points (European Credit Transfer System), which corresponds to three years full-time study, of which 30 ECTS (equivalent to six months work) must be obtained by completing PhD-courses, in addition to 840 hours which must be spent on teaching/work obligations at the department level. The PhD can be funded in various ways, though the most common in Denmark is a PhD studentship funded by a university or an industrial PhD, which is then partly funded by an industrial partner (Wichmann-Hansen & Herrmann, 2017, p. 5). The PhD thesis is either article-based or written as a monograph. The thesis is submitted at the end of the study and reviewed by a committee of two external examiners and one internal examiner from the home department. If the thesis is passed, the PhD student will then defend the thesis at a public defence a few months later.

Methods

This paper is based on interviews with PhD students and PIs from five case projects selected from the 18 research-projects in the Excellence Programme (see table 1). The five case projects were selected on the basis of being most different from each other (Beaulieu, Scharnhorst, & Wouters, 2007; Flyvbjerg, 2006). Whereas the projects thus varied in size, scope and affiliation, they also varied in terms of stated ambitions for the educational activities and in which faculties the PIs were placed.

As shown in the table, the PhD students were enrolled at various faculties, while being part of the case projects, which meant that, in some instances, the PhD students were enrolled and working from other faculties than the PI and project management. The interviews were part of a larger ethnographic field study (Marcus, 1995; Willis, 2000) which entailed participatory observation in various educational settings, in addition to document analysis of project applications, midterm evaluations and email correspondences related to the planning of the educational activities (see Lindvig, Lyall, & Meagher, 2017).

Table 1: Overview of interviewed PhD students, PIs and their Faculty affiliation

Case / Faculty	Case 1	Case 2	Case 3	Case 4	Case 5	Total
Nat Sciences	1	1	1		3	8
Health	2	3			1	7
Social sciences		2		4		8
Law	1	1				3
Humanities	1	1	2		1	7
Number of PhD students + PIs	5 +1	8 +1	3 + 1	4 +2	5 + 2	32
Number of interviews with PhD students + PIs	3 +1	4 +1	2 +1	4 +2	2 +2	22

Affiliation of interviewed Case-project PI and Co-PIs

All the interviews were semi-structured (Kvale, 2004; Merton, Lowenthal, & Kendall, 1990) and based on thematic interview-guides. Whereas both single and group-interviews were conducted with the PhD students, the PIs and Co-PIs were interviewed individually. In total, 22 interviews were conducted with a total of 32 interviewees. The initial topics driving the interviews were issues related to being part of interdisciplinary research projects and of interdisciplinarity as a joint denominator for the projects and the researchers involved. While the interviews with the PIs were conducted without prompts, by way of inviting the students to reflect further on these issues, two exercises were part of the student-interviews:

In the first exercise the students were asked to pick a card among 20 postcards. The postcards were a combination of free postcards picked up at cafés and restaurants, of museum cards depicting famous art pieces, in addition to renderings and drawings of various geographical destinations. In picking a postcard the students were asked to find a motive that they somehow associated with *interdisciplinarity*. This was the only criteria. The exercise was meant to work as an icebreaker in the group interview, in

order to shift the power dynamics in the groups and get the students to interact and actively take on the role as co-constructors of the interview (Kvale, 2007). Furthermore, it was meant to invite reflections on differences between interdisciplinarity widely understood and interdisciplinarity in relation to the research project, they were involved in.

In the second exercise, the students were each given a horizontal timeline, drawn on a large piece of paper. The students were then asked to each spend a few minutes jotting down on to the timeline what they so far had experienced as *highs* and *lows* in their PhD study, beginning on the day they were accepted as a PhD student. Subsequently they were asked to present their timeline to the interviewer and to the other students present. The use of timelines is well-known in literature across various research fields, and particularly linked to life story interviews (Carey, Carey, Maisto, & Henson, 2004; Goodson, 2001) with only a few having described the concrete methods and uses of it in other contexts (Adriansen, 2012). In these interviews, the purpose of the timeline was to let the students reflect on their ways of navigating through interdisciplinary projects; to understand the events that had characterised and affected their PhD time the most – and finally to explore any connections and similarities between the various timelines and events, spanning across research fields, faculties and projects.

Though the students individually chose the postcard and individually filled out the timelines, many discussions followed in the wake of the exercises. In the group interviews, the exercises created common ground and were natural conversation starters, as the students were quite curious to learn about the others' choice of postcards and what had been added to the timelines. As Merton et al. (1990, pp. 12–13) state, one of the general reasons for using interviews, rather than questionnaires, is to uncover a diversity of responses whether or not these have been anticipated. In these interviews, the diversity was not as surprising as the unanticipated directions taken: while the interview guides were mostly about issues related to interdisciplinarity, the interviews were about everything *but* interdisciplinarity.

Analytical framework

The 'implied student' is an analytical concept introduced by Ulriksen (2009) by means of highlighting the expectations of students, teachers, the institutions, the educational system, and the encounter between them. These expectations altogether create the implied notion of what a student looks like in the given setting, and thus affect how the system, institution and teacher will assess the individual student and in return how the student

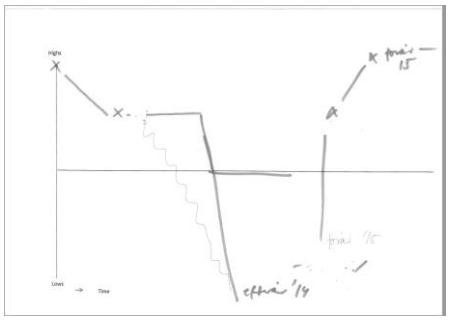
will assess the setting to fit him or her (Ulriksen, 2009, p. 518). Similar expectations exist within the academic community, between disciplines, departments and various faculty and are all part of being socialised into a discipline or community of scholars (Becher, 1989; McAlpine & Åkerlind, 2010).

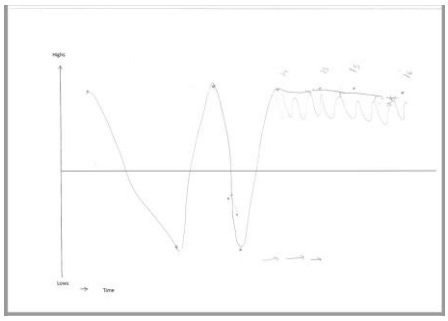
In analysing the empirical data, the 'implied student' has worked as a *sensitizing concept* (Blumer, 1969, p. 150). A sensitizing concept can derive from the empirical material, just as it can provide new directions along which to look. In reading through the anonymised, ad verbatim transcribed interviews, discussions of expectations, conflicting demands and ambitions started to 'glimmer' (see MacLure, 2010, p. 282) , thereby gathering our attention. This led to the use of the 'implied student' as this concept was wide enough to embrace the diversity of the material and let the details of the material glow, yet still giving direction to the study. The examples and the details leading to, and further highlighted by, the 'implied student' will be presented in the following analysis.

Findings

In the interviews, the PhD students talked about expectations and structures. The PIs talked about structures and the role and responsibilities of PhD students. Questions regarding *interdisciplinarity* led to and highlighted issues related to the students and their enrollment in the case projects. Nonetheless, as will be apparent in the following section, these issues are not necessarily linked to interdisciplinary aspects of the projects, and could be true for students at other levels, involved in other projects as well. I will return to this later.

Accomplishments and Blurry Expectations





The timelines drawn by the PhD students look like echocardiographs of atrial fibrillation (see image 1 and 2), with highs and lows experienced to varying degrees. A common denominator for these timelines were the highs relating to visible accomplishments achieved, and lows depicting the blurry expectations and lack of time (see table 2 below for examples):

Table 2: Examples of 'highs' and 'lows'- statements on timelines from PhD-interviews

Highs	Lows
'International conference'	'What are my real responsibilities'
'Publication out'	'What is expected of me?'
'Conference paper accepted'	'Too little time!'
'Research stay abroad'	'Shift focus'
'My own fieldwork begins'	'Pushed by extra assignments'
'Yay! – starting'	'Delays because of the others in the project'
'Found my spot'	'Dragging out'
'Good results'	'Never ending testing'
'Writing and presenting paper'	'New discipline - or?'

The highs on the timelines were identified as the tangible outcomes of the study – an accepted article, a research stay, participating in a conference or getting good reviews on a presentation. The lows were marked as the ambiguity and confusion in what was expected by the PhD students, which would sometimes lead to delays, time-pressure and stress:

> When I started, I really didn't know what to expect and then we had these meetings and - at the start it was very often once a month, and I was introduced to all these different ways of thinking and speaking

> and it was all very confusing. I'm on my final year now, and I've just in the last few months realised that I need to become much more engaged with my own discipline, because, this is how my PhD is going to be judged and whether or not it will awarded is based on researchers within that field. (PhD student, interview D, S1)

In this quote the student describes the difficulties in focusing and narrowing in the research, and also the need to make it fit the discipline, he belonged to. The requirements of the home discipline were a reoccurring topic:

> I have to remember to stick to my own guts, cause I am doing a PhD within this field and so I shouldn't like construct it as a Law PhD for instance, cause that would be, then they would not accept my PhD, so in a sense you will be open to being inspired but still a bit reluctant to take all of the inspiration and good advice into your project. (PhD student, interview D, S2)

Throughout the interviews, the PhD students returned to the expectations of writing the thesis within their 'own discipline', of 'staying with their peers', of 'protecting themselves', and of 'the need to have their work recognised as a proper thesis within their own discipline'. These expectations confirm the image of independent researchers, staying and learning to become part of certain, specialised research fields, as described in the qualifications framework and in the literature on doctorateness (Bologna Working Group, 2005; Trafford & Leshem, 2009).

> I wouldn't be able to publish in an xx journal if I wasn't placed in this department, you know, there is this kind of basic understanding of what interests researchers within the field of xx – and you need to have that understanding in order to address them properly, so you could say - I sit next to my readership and I see that as quite crucial. (PhD student, interview C)

In Bernstein's terminology, the PhD programme at UCPH carries a strong classification (Bernstein, 1975, pp. 59–60) which means that the boundaries around the PhD programmes are sharply drawn. The Danish rules and regulations of PhD programmes are not demanding a monodisciplinary approach per se; however, because the Danish and Northern European structure builds on departments and PhD-schools (Baker & Lattuca, 2010, p. 816), which in the UCPH setting are primarily tied to certain disciplinary fields within different faculties, there are limited ways in which the PhD students can deviate from the standard and piece together their own PhD. In the postcard exercise, this also became apparent:

Handcuffs and a bus-station

While many different postcards were discussed during the interviews, a few postcards were picked repeatedly. One of these postcards depicted a busy bus-station, filled with people selling fruit and vegetables and with the buses in the background. One student used the postcard to describe the expectations put forward by the project design: while the PhD students were expected to each fulfil their own requirements of belonging to a home discipline - of 'selling different vegetables' - they were still expected to work for the common goal and at the end – 'get on the same bus'. Similar reflections were aired in connection to another popular postcard displaying a set of handcuffs:

> I think sometimes there is marginal consideration behind the interdisciplinary approach which kind of handcuffs each discipline to its own work. And the problem arises when you have to – when that interdisciplinary part is expected to be delivered. (PhD student, interview B, S2)

The students quoted above saw a strong division between the monodisciplinary research they, due to their respective backgrounds and departmental affiliations, were expected to bring to the research-project, and then the joint, interdisciplinary contributions they had to deliver towards the end of projects; the problem being that the monodisciplinary parts wouldn't necessarily fit together. Because the roles of the various researchers in the projects were so defined from the disciplinary perspectives, the interdisciplinary aspect was experienced as the thing actually handcuffing each researcher to a specific discipline. Even though the postcards were only used in the interviews with the PhD students, the interviews with the PIs reflected similar views and expectations.

The projects are bigger than themselves

According to Ulriksen (2009, p. 520), the 'implied student' of a university study programme at bachelor's and master's level equals the sum of the expectations created by a curriculum, teaching and assessments, teachers, other students, a study structure and an institutional culture and tradition. In comparison, a PhD study-programme (in a Danish context) comprises a home department, a Head of Department, supervision, a range of courses and teaching obligations, dissertation and defence regulations, in addition to a disciplinary tradition in a wider community of scholars and other PhD students.

For the PhD students in this study, an extra set of expectations was created by the interdisciplinary research projects:

> It's just another kind of pressure – the projects that these guys do, they are bigger than themselves. So many people are involved. It's not just about you running around, for a week, feeling a bit guilty that you haven't done enough. Because then the emails from around the world starts ticking in – people saying 'ugh now what', 'should we have a skype meeting' and 'how far are you?' So in general the people working here are really ambitious. I think all PhD students work a lot – but my guess is that these guys work more than most other places. (Co-PI, Case 5)

The PIs expressed expectations similar to the PhD students and the official guidelines; however, they also aired expectations of the students as team-players, working hard and thinking more of the project than on their 'own little project'. What the PIs all emphasized was the importance of the collaborative work and that the PhD students would share material and comply with the joint project.

> If you are granted research money and have promised - the PI has promised - to answer a set of specific research questions in return for the money, then it really is a problem if the PhD students don't consider it their job to pursue these questions. That causes problems for the PI who then has to go back to the fund and say 'so sorry, I couldn't do that, because the PhD students preferred to move in another direction'. (PI, Case 2)

In the interviews, some of the PIs expressed frustrations with the restrictions made by the institutional structures that tied the PhD students to the departments and left the projects with little, if any, say over the students. Even though more PIs in the interviews emphasised 'a strong monodisciplinary foundation as prerequisite for strong interdisciplinary research', they were still frustrated with the regulations of the departmental PhD programmes, requiring the students to conform to departmental publishing traditions and discipline-based ways of approaching research and fieldwork. And while the PIs on the one hand agreed that the PhD students should be monodisciplinary, they also had expectations of the students tying the projects together, as they were the ones 'moving across the faculties'. One of them contrasted this to the situation of individually funded PhD students:

> If you [as a PhD student] had applied for the open studentships, you would have formulated the project yourself and you would have fought to bring home the money, right – but when you are hired onto a

> project, you are embedded in something completely different, and it appears that the management at the faculty has not quite understood that. (PI, Case 3)

This made the PIs conclude that the interdisciplinary work could not be left with the students, as expected from the outset:

> The PhD students are not the ones who should carry these kinds of interdisciplinary projects, I really think that is a wrong perception; also that they should be the ones responsible for the interdisciplinary aspects - that is not true either. That should be the responsibility of the senior levels – not least because; I have yet to see a genuinely interdisciplinary PhD committee. (PI, Case 3)

Discussion and implications

The findings above illustrate the multiplicity of expectations to PhD students affiliated with large interdisciplinary research projects within faculty-based, monodisciplinary structures. The interview-material tells of PhD students expected to be individual disciplinary representatives, committed team-players, in addition to hardworking employees, meeting the requirements from the external funds and from the research-management. While the various expectations mirror those of students in other contexts (for an extensive overview, see Winchester-Seeto et al., 2014), to an outsider, these expectations may seem equally high, diverging and difficult to navigate. Yet, the PhD students did and do navigate through these expectations. Many of the PhD students have already graduated and as this paper is written, the last PhD students of the cohort are preparing their dissertations. Instead it becomes important to understand exactly what is causing these diverging expectations - and what are the implications?

Distinctively local

The Excellence Programme is distinctive. It is unusual to award 64 million Euros within one single institution, without any institutional changes being made, just as it is uncommon to prioritise projects crossing physical boundaries (i.e. faculties) over disciplinary boundaries or level of integration. Furthermore, recent studies have shown significant differences in the level of directive supervision for PhD students within the natural sciences and the social science and humanities (Wichmann-Hansen & Herrmann, 2017), just as the type of dissertation and role of articles also vary greatly from field to field. This, in addition to the expectations arising from the local PhD-schools and faculty PhD-programmes may also have created a clash in expectations when the PhD students moved between the faculties.

Interdisciplinary or not

Interdisciplinarity is a contested term, with many definitions applied, depending on the level of integration between disciplines (see Klein, 1996; Lattuca, 2001; Repko & Szostak, 2017). Meanwhile, it is worth noticing that, in addition to the lack of PhD students from applied sciences, according to the Programme's mid-term evaluation (2016), only a few of the 18 research projects achieved what Repko and Szostak (2017, p. 223) define as 'full' or even 'partial integration' between the various disciplines involved. This echoes findings from an evaluation of the European 5th framework programme, where almost no disciplinary integration was found, although the official aim of the framework programme was exactly to achieve that (Bruce, Lyall, Tait, & Williams, 2004, p. 468).

Discrepancies between named intentions and realities in interdisciplinary research projects arise for many reasons. Some are related to institutional restraints (Townsend, Pisapia, & Razzaq, 2015), whereas others are due to more local, collaborative issues (Rabinow, 2012). In the Excellence Programme, various reasons were at play, including a rather blurry definition of interdisciplinarity and of what was expected to be achieved by the projects. This could be said to contribute to the mix of expectations facing the PhD students in the projects.

It is interesting to note that while most of the work in the research projects lacked integration and even though the majority of PhD students claimed a stronger monodisciplinary identity following their work in the interdisciplinary research projects (echoing findings from Geschwind & Melin, 2016), the PhD students did in fact work and write across disciplines in their home departments. They published articles with colleagues from other disciplines, supervised bachelor's and master's students from other subjects and applied methods introduced by other research fields. This was just not considered 'interdisciplinary' by the PhD students or the PIs, but merely 'collaboration between colleagues with different competencies' or 'students visiting another disciplinary culture'. This could point towards the performative aspect of interdisciplinarity, and the idea that only certain types of disciplinary crossings were considered interdisciplinary (e.g. Becher, 1994; Callard & Fitzgerald, 2015, p. 2). The view of interdisciplinarity expressed in the research projects - as something removed from the everyday research practices - could essentially prove to inhibit interdisciplinarity instead of augmenting it, as it would then appear difficult and risky to achieve (Rhoten & Parker, 2004) .

Changing funding structures

In the study, the PIs expressed their frustration with their lack of power over the students, due to the enrollment at department level. Even though the PhD students were recruited by the projects, they were still 'owned' by the departments. Thus, while the Excellence Programme and the funding of 18 research projects did not alter the institutional structure at UCPH, it is, nonetheless, a sign of the changing funding structures in higher education, with public core funding decreasing and strategic project funding increasing (Wichmann-Hansen & Herrmann, 2017). Changes in the funding structure of universities and university research has proven to be a main factor that affects the ways, in which universities and faculty make their decisions on teaching, research and administering (Tammi, 2009, p. 657). In the five case projects, the funding was certainly driving PIs' expectations of delivery and efficiency for the PhD students.

On the PhD students timelines, the *highs* were the defined activities and tangible goals achieved; the *lows* were the messy parts of delays, unexpected turns, extra assignments and blurry results. The PhD students stressed the puzzle in having to fit into a confined disciplinary role, while simultaneously expected to cross boundaries and deliver the predefined results, as promised.

> There is a new 'grammar' of training, curriculum and assessment in which practice is parsed into component parts and recombined in an inflexible, linear syntax that allows only one route through a bounded area of knowledge. (MacLure, 2006b, p. 5)

MacLure describes education's 'other' as 'the pain, conflict, failure, chance, irrationality, frailty and singularity implicated in the rationalist projects of teaching, learning and research' (MacLure, 2006a, p. 224). This 'other' is forced out in favor of the 'new' grammar as described above. What is not evaluated, is not valued, and thus repressed. When looking at the timelines and the postcards depicting handcuffs, crowded bus-stations and barbed wire borders; when the students talked about not wasting time on 'new collaborations'; and when the PIs called out the high-ranking journal article as *the* goal of the PhD student at the expense of 'writing the nerdy, lower-ranking articles that you learn so much from' - this education's 'other' came to mind. The PhD students in these projects are expected to be many things; however, insecure, experimenting, failing or unruly are not among them (mirroring findings in Devenish et al., 2009).

Conclusion and further perspectives

The implied PhD student of interdisciplinary research projects is created by the expectations aired by people, interpreting rules, regulations and institutional structures of a faculty-based university while affiliated with interdisciplinary research-projects. The students navigate through all of these expectations by limiting the room for improvisation and experimentation. When unexpected turns do occur, they are perceived as frustrating 'lows'. It would seem that if the institutional structures are not restraining the routes available to the PhD students, then the multiplicity of expectations will. The implied PhD student in this setting is thus neither monodisciplinary nor interdisciplinary – but disciplined.

While the Excellence Programme of Interdisciplinary Research at UCPH is a distinct case, the findings in this study are likely to reflect those of many research intensive European universities, where strategically funded research projects enroll PhD students within and alongside traditionally monodisciplinary structures. This calls for further attention towards the accumulation of expectations directed towards PhD students, and of the resulting exclusion of the fuzzier, yet crucial parts of the PhD study. Furthermore, it calls for more research on the changes in core- and strategic funding of research and the possible move towards more directed and less flexible ways of conducting research.

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PAPER IV

Strategically unclear: Exploring an Excellence Programme of Interdisciplinary Research

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Strategically Unclear: Exploring an Excellence Programme of Interdisciplinary Research

Abstract

While attention within the STS community has been made to the political and strategic level of interdisciplinary research as well as to the personal levels of interdisciplinary collaboration, only few accounts focus on the mundane experiences of how strategic demands for interdisciplinarity meet, interact and change existing research practices and products within higher education. In this paper we argue that the enactment of interdisciplinarity as a 'unified concept' is used as means to establish strategically unclear calls for interdisciplinarity, resulting in interdisciplinary window-dressing of mainly monodisciplinary products at the ground levels of research. Drawing on an ethnographic field work in a Danish interdisciplinary research programme, we argue that a multiplicity of incentives and motivations behind the programme has rendered the call for interdisciplinarity strategically unclear. Taking areas such as writing and publishing, collaboration and educational development as a case and exploring the work being done in these fields within five research projects in the research programme, we discuss the products and outcomes of a strategically unclear call for interdisciplinarity and the repercussions for funding and organisation of interdisciplinary science and research.

Introduction

> People do not talk about making interdisciplinary practices accountable. I have not come across *measures* of interdisciplinary success (Strathern, 2004, p. 78)

In 2013, the University of Copenhagen (UCPH) launched the Excellence Programme for Interdisciplinary Research (hereafter the Programme) and awarded 18 interdisciplinary research projects spanning across the university a total amount of 64M Euros. The projects selected were focusing on themes such as obesity, climate change, genetic engineering, big data and ageing. The 18 research projects became an extra, non-physical space at UCPH, referred to as the '2016-projects'. Once a year the PI's from all the projects met in the buildings of the Carlsberg foundation to present their projects. In these settings, interdisciplinarity was described

vaguely as an ideal of true integration amongst disciplines, of perfect collaborations and accompanied by appraisals of the importance of interdisciplinarity in solving society's grand challenges. Meanwhile, in offices and labs around the university, the researchers enrolled in the projects would mention how this image of interdisciplinarity, praised and promoted in official settings, was not at all *reflected* in their everyday work and far from what they experienced. Some of the junior researchers in the projects had even been advised against taking up interdisciplinarity.

As a medical anthropologist and an educational ethnographer working within this Programme, we too experienced the ambiguity linked to the term interdisciplinarity; not least because our specific task in the Programme was to study interdisciplinarity in various constellations. Although the Programme was named interdisciplinary and to the outside world presented as an example of an ambitious and strategic push for interdisciplinarity from the university management level, there was, nevertheless, a lack of definition and engagement in the practical operationalization of interdisciplinarity: while the researchers knew that they would be measured on their interdisciplinary efforts, they did not know on what grounds. The starting point for our investigation was therefore the trickle-down effect of programmatic strategic statements down to local practices of interdisciplinarity.

Nowotny and colleagues have interpreted the increased focus on interdisciplinarity as a result of research agendas now, more than ever, are influenced by public concerns (Gibbons, 1994; Nowotny, 2013). The same agendas have also been called politically enforced (Jasanoff, 2010) and the push for interdisciplinarity seen as new way of securing accountability of research (Barry & Born, 2013a; Strathern, 2004). While Interdisciplinarity is not historically novel, the political and discursive mobilization of interdisciplinarity is. Since the 1990s it has intensified and affected central funding bodies to a degree of which success in obtaining a research grant now often entails showcasing interdisciplinarity and putting together research teams across both disciplines, faculties and industries (FP7; Horizon2020, NSF, IGERT).The launching of interdisciplinarity in these programmes as the complex measure to solve society's 'grand' challenges (Frodeman, Klein, & Mitcham, 2010) 'by creating so called 'synergies' (Bruce, Lyall, Tait, & Williams, 2004; C. Lyall, 2013) has transformed contemporary academic practice and sparked off new actors and activities. Barry and Born have pointed to the dominant narratives of interdisciplinarity and stated that the contemporary discourse of interdisciplinarity has left the whole field with a notion of interdisciplinarity as a 'unity' (Barry & Born,

2013a, p. 5). This unity not only obscures local heterogeneities but it also makes the term interdisciplinarity in each case appear the same (Nersessian & Newstetter in Johri, 2014, p. 714). The many definitions and conceptualisations gathered in the 'unity' of interdisciplinarity thus render the concept even more unclear and nonspecific.

This paper is a response to the contemporary discourse on interdisciplinarity and investigates how unclear articulations of interdisciplinarity at a strategic level affect practices of writing, collaborating and educating at the local and mundane level. Based on ethnographic fieldwork across five selected case projects within this programme, including focus groups and workshops with junior and senior researchers, we join the discussion of interdisciplinarity as a politically and strategically motivated concept, while simultaneously adding to the limited, though steadily increasing accounts (Barry & Born, 2013a; Callard & Fitzgerald, 2015; Fitzgerald, Littlefield, Knudsen, Tonks, & Dietz, 2014; Rabinow, 2012) of everyday experiences and work practices resulting from and affected by strategic and unclear calls for interdisciplinarity.

The aim of the paper is thus not to show the *discrepancies* between strategic calls at the upper levels, and mundane, local research practices; rather, it is to show that the performances of interdisciplinarity at the ground level is a *direct* result of a strategically unclear call for interdisciplinarity at the upper level - and to discuss how the unity of interdisciplinarity (Barry & Born, 2013a, p. 5) produced in these strategically unclear calls has major repercussions for future development and funding of interdisciplinarity.

Setting

The University of Copenhagen (UCPH) dates back to 1479 and it is by far the oldest university in Denmark. In 2007 the university merged with The Royal Veterinary and Agricultural University and the Danish University of Pharmaceutical Science. In 2011 it was decided to merge the four faculties within science and medicine to two faculties, so that the university currently has 6 faculties (Science, Health, Humanities, Social Science, Law and Theology) which are very different in size. Science and Health each has a share of about a third of the total turnover in UCPH, while the faculty of Theology is much smaller than the departments within science and health.

UCPH has developed as a research intensive university with an organizational structure primarily based on disciplines. However, the

merger with the two other universities in 2007 also integrated research and teaching environments which were traditionally oriented relatively directly at professional and industrial areas with a need for multidisciplinarity. In addition, there has been a continuous movement towards the creation of larger departments, which means that most departments in Humanities, Science and Health today contain a number of different disciplines. Despite these developments, excellence in research has often been associated with mono-disciplinary strength and it was not until a new 'Strategy 2016' was launched in 2012 that the university explicitly put interdisciplinarity on the agenda.

As part of the Strategy 2016, the Excellence Programme for Interdisciplinary Research was set up in order to boost interdisciplinary research at the university, while at the same time preparing for the calls in Horizon 2020 - the European Research Framework. The Programme call came out end of June 2012 and two months (over summer) was provided for the researchers to prepare the submission of first round of interest, following two months before deadline for the final project applications. In total, it took 8 months from the first call for applications to the final announcement of 18 funded projects.

In a survey conducted by the National Academy of Sciences, the three most accepted ways of enhancing interdisciplinary research is identified as' fostering a collaborative environment', 'providing faculty incentives including hiring and tenure policies' and 'providing seed money for Interdisciplinary research projects' (National Academy of Sciences, 2004:86). Out of these three, fostering collaborative environments and providing faculty incentives have been considered the common measures when promoting interdisciplinary research at single institutions (Jeffrey, 2003; Kezar, 2006, 2012; Townsend, Pisapia, & Razzaq, 2015). However; this was not the case with the Programme, which, by the university management, was named 'seed money' to initiate new interdisciplinary research projects with great potential to attract funding from strategic interdisciplinary research programmes'(Bock et al., 2016, p. 1). This makes the Programme somewhat distinct from other institutional initiatives promoting interdisciplinarity – and resemble major national and subnational research programmes, such as the 5th European Framework Programme (Bruce et al., 2004), NSF and the UK Research Councils (Strathern, 2004).

Nonetheless, while no changes in the institutional or hiring structures were made to accommodate the interdisciplinary research, inclusion across faculties was still an aim of the Programme: since the funding for the

Programme only included researchers from and within the University of Copenhagen, the Programme was an attempt to consolidate the university as one institution in the wake of two the large institutional mergers. To enhance the consolidation further, precedence was given to projects able to gather researchers from all six faculties, more than on projects with the largest variety of disciplines included. As a result a relatively small faculty such as Law had researchers involved in 16 out or the 18 projects. Moreover, out of the 18 projects selected from the total of 37 applicants, only a minor part had researchers from departments of (interdisciplinary) applied sciences (e.g. forestry studies or development studies) represented in the projects. All of the projects had researchers sitting at different faculties from the Primary Investigator, and only a few projects managed to set up facilities for the researchers to sit physically together.

Thus, while the aim was to align and connect research across the university, the incentive behind the Programme was never meant to fundamentally change the structure of the university. In the Danish version of the call, the word 'interdisciplinary' was not used; instead the term 'tværgående', meaning 'crosscutting', was applied. Furthermore, the university management made no special arrangements to imbed the research projects in the existing structure; instead it was up to the faculties - in which the PI's of the research projects were anchored - to decide the afterlife of the research projects as the funding ran out (University of Copenhagen, 2012).

The question we are left with is thus what kinds of expectations and outcome a call for interdisciplinarity raise, especially when the call is unclear both in terms of defining interdisciplinarity and the evaluation criteria?

In the following section we will elaborate on our roles as researchers in the programme, hence the perspectives from where the subsequent analysis is based.

Methods and analytical framework

As part of Strategy 2016 the University of Copenhagen also set up an initiative to improve education and teaching across the university. Eight projects were granted a total of 6m. Euros and ran until summer 2017. One of these projects aimed to improve interdisciplinary and cross-faculty education and Lindvig (author) was enrolled as a PhD student in this

project. Her position in the project was made possible due to her prior engagement in a pilot-project mapping interdisciplinary research and education initiatives at the university. Since the results from this project became the cornerstone in the new application for the project on interdisciplinary education, she was an obvious candidate in building on this as part of a PhD study. For a long time, however, her enrolment was considered a bit of a backroom deal, as these projects were named ‘educational development projects’, thus not considered research, involving researchers, by the university management.

Hillersdal’s (author) possibility of getting a postdoc on interdisciplinarity in the Excellence Programme arose as a spill over project idea from a large project on lifestyle diseases in which she did her PhD. Part of her field work on the lived experience of eating involved close collaboration with a nutritional physiologist and an endocrinologist on gastric bypass patients understanding the variations in weight loss after surgery (Hillersdal, Christensen, & Holm, 2016, 2017) This experience led her to pursue new possibilities of collaborating on biosocial phenomena connected to obesity, and she contributed to a project application which was eventually granted money and became one of the 18 research projects.

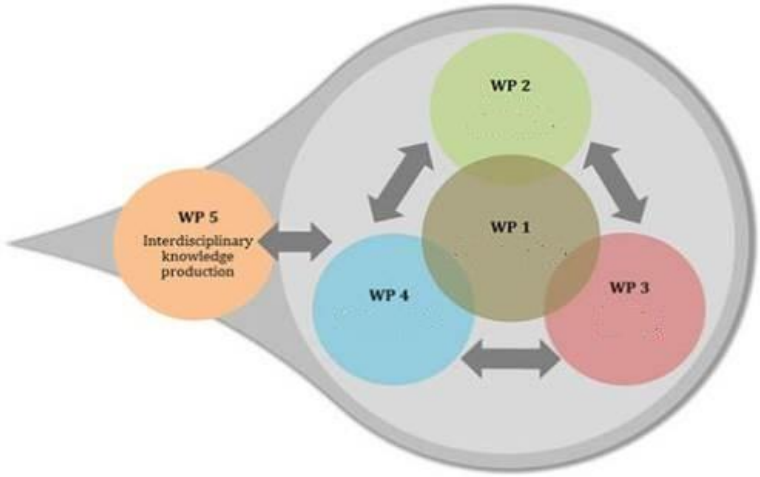

Figure :1 Project model

The project involved researchers from various parts of biomedicine, the social sciences and the humanities. The project model on the figure above illustrates how the research was structured and organised into five interdisciplinary work groups, in which different dimensions of the problem of obesity were addressed. Here, Hillersdal’s work-package was depicted on the side and therefore not integrated (symbolically at least) with the other work packages. It was also different in size as Hillersdal was the only

full time researcher in the work package compared to the other WPs with up to 10 researchers in each. The assignment of interdisciplinarity in its' own place was intended to boost the interdisciplinarity in the project but in effect the externalisation became more of an exclusion as Hillersdal suddenly found herself more in the role of an observer of research conducted in the other work packages and not a collaborator. These conditions also made the responsibility for the anchoring or commitment to her work hard to prioritize for the other WPs.

The reason why we stress our own recruitment and positioning in the projects is because it was these situations and experiences that made us interested in exploring how interdisciplinarity become organised both socially and materially. The analyses in this paper are based on empirical material collected in the projects, and the views and examples naturally reflect the access we have been granted in and to the projects, as 'double insiders' (Adriansen & Madsen, 2009). Our positions have given us a unique opportunity to follow more research projects simultaneously and to study how the same overall framework and conditions created very different results in the projects. The analysis in this paper therefore builds on individually collected empirical material, collected using ethnographic methods (Marcus, 1995; Willis, 2000) across five selected case projects in the Programme (one of which Hillersdal were part). In Hillersdal's fieldwork she followed meetings in the project work packages with a focus on how the researchers from different disciplinary fields found ways to collaborate, hence how they made their data comprehensible and relevant to each other and on the concrete formats of communication developed in the course of the projects to support the interdisciplinary exchange. Lindvig followed the development of educational activities such as elective courses and summer schools, created by her five case projects. She observed staff meetings and teaching, interviewed course managers, teachers and students in addition to collecting course material, student assignments and course evaluations. As part of the trailing and following interdisciplinarity in empirical data spanning across the projects, informants were asked to describe how interdisciplinarity was named, took place or experienced in the projects. This was done to ensure that attention was given to spaces or practices not reflected in documents, reports or through our primary observations.

Similar to Svendsen and colleagues (Svendsen, Gjødsbøl, Dam, & Navne, 2017) who have collaborated and integrated empirical data from different field sites, we draw on material from own individual field work in our joint analysis. Through our situated perspectives on the question of

interdisciplinary we have attempted to achieve what they term “thickness by comparison” (Svendsen et al., 2017, p. 205). This point to the richness in the material but most importantly the ability, through the difference in perspective, to question taken for granted notions in an academic culture, we ourselves are part of. The difference in perspective is apparent when reading through the analysis, as some examples are based on accounts on a local group-level, whereas others show a cross section of details from the five projects. Being part of projects within the same Programme has also meant that we, in retrospect, have interviewed or observed some of the same persons and collaborations. As a result we have anonymised all material that we shared with each other in the analytical process, in order not to compromise the trust given to us by our interlocutors[1].

This study is thus motivated by our own experiences, just as the methods and analytical strategies used in this study reflect our various research backgrounds.

In the study, as we follow processes and products of interdisciplinary efforts in a particular strategic set-up, we do not apply the term interdisciplinarity as a category belonging to a specific taxonomic ordering of degrees and versions of inter-, multi or transdisciplinarity. While we acknowledge the need to pin down and define such a vague term, we argue that the various taxonomies and definitions are closely linked to certain disciplines and thus represent particular and limited ways of studying interdisciplinarity (see Jeffrey, 2003; Strathern, 2004). In order to move across disciplinary fields and boundaries, we instead take a very wide approach to interdisciplinarity (cf. Moran, 2010) which allows us to revisit interdisciplinarity in the making and let us explore the pragmatics and situated concerns as it unfolds in research practices.

With an emphasis on exploring interdisciplinarity as a particular contemporary space for research (Callard & Fitzgerald, 2015, p. 4) and the local and mundane effects and practices of interdisciplinarity, we situate ourselves in the intersections of STS, medical anthropology and the steadily growing research on collaboration within emerging biosocial fields (Balmer et al., 2015; Catherine Lyall & King, 2016; Vermeulen, Parker, & Penders, 2010).

The role of social scientists in techno-scientific fields has led researchers to analyse the socialites of collaboration as ‘trading zones’ (Gorman, 2002),

[1] Throughout the paper, the excerpts from our empirical material are thus only referenced with context and position level.

‘boundary objects’ (Star & Griesemer, 1989), and attributing roles such as (cultural) ‘brokers’ and ‘mediators’ (Suchman in Barry & Born, 2013a). Researchers involved in collaboration between disciplines and more explorative interdisciplinary projects have emphasised the personal implications and emotional aspects of partaking in collaborations consisting of often unequal power relations (Calvert & Schyfter, 2017; Fitzgerald et al., 2014; Rabinow, 2012).

In reflecting on collaboration in a transdisciplinary project, Fitzgerald et al. (2014) conclude that the mundane pragmatics of collaboration took place within a ‘rather less transparent, rather less unified and rather less propitious sphere of interaction and exchange (Fitzgerald et al., 2014, p. 703). Based on this realization, they suggest an ethics of ‘equivocal speech’ as a way to constructively work and ‘work out’ collaborations in projects involving various disciplines. When Fitzgerald et al suggest an ethics of equivocal speech they not only respond counter to Rabinow and Bennetts (2012) call for clarity and frankness but also state the differences between ideal descriptions of interdisciplinary collaboration and of the mundane practices of interdisciplinary research projects (Fitzgerald et al., 2014, p. 703).

Whereas Rabinow and Bennett center on processes at the local level, in order to understand the outcomes of research collaboration, we explore how the incentives; the calls and evaluation practices set forth at the upper strategic levels affect local practices. And whereas Fitzgerald and colleagues conclude that they succeeded in the project (not despite of) but because of ‘equivocal speech’ among the peers at the local level (Fitzgerald et al., 2014, p. 716), we instead wish to discuss the local outcomes of strategically equivocal speech at the upper levels of an institution-wide initiative.

In the following, we analyse how articulations of interdisciplinarity at a strategic level affected local and mundane practices of writing, publishing, educating and collaborating. We explore objectives and aims set forth in the Programme call (including interdisciplinarity as an objective) and how they have materialised into certain practices and products.

Processing strategic aims and local achievements

Writing and publishing

Writing articles and planning a publishing strategy are central success criteria within any kind of research today and publishing in research teams has been observed to be a general trend within academia and furthered within interdisciplinary projects (Hicks & Katz, 1996). In the Programme midterm evaluation, publications were ranked second, just under scientific discoveries.

In the projects we have followed writing and publishing has played a significant role as a hotbed for experiencing and showcasing interdisciplinarity which also points to co-authorships as a central way of measuring collaboration (Iglič, Doreian, Kronegger, & Ferligoj, 2017). During fieldwork we witnessed a range of attempts from project management level to motivate shared writing and co-authoring across disciplines.

Across the projects, one particular article template was applied repeatedly to accommodate interdisciplinary writing. This was the traditional *material and methods article;* a well-established format to at least researchers from natural and life sciences. It was originally designed to secure the rigor and validity of mainly clinical trials by publishing the descriptions in a comparable and replicable format (Elsevier.com, 2017). The format contains a description of the project intervention or trail, main hypothesis and expected outcomes. In our case projects, the interdisciplinary writing processes were not planned differently from other types of writing processes and a common argument voiced was that by bringing different disciplines to the same table, collaborating around an already specified problem would eventually produce interdisciplinary articles. By means of using the materials and methods format, researchers from the humanities and social sciences were included and given a paragraph similar to their project colleagues from the natural sciences to state their research aims in relation to the project. Asked about writing with other disciplines a junior researcher from the social sciences collaborating with biomedical researchers running a large trial on cardiovascular disease, commented in the following way:

> R: At our first meeting [in the work package] ‘interdisciplinary publications’ was listed as the last point on the agenda - that was years ago. Then, at the meeting held recently, the interdisciplinary publication came up again.
> I: So it had been on the very first [agenda]?

> R: (…) and was only taken up two-three years later. I think that is quite telling of the way it's prioritised, right? Then, the way it was raised, just made me think, what the hell? Are you serious? The interdisciplinary product, they were suggesting, was a paper you would define as a material and methods paper, within their field - an article, where you describe the intervention, and then say "well, the intervention is about such and such, there were these three groups and we applied these methods,
> I: Was that the interdisciplinary publication?
> R: Yes, and you know, everything was already stated in the project description and in their individual project descriptions, so it was really just a matter of cut and paste. (Interview, junior researcher)

In the quote above, the junior researcher describes how the aim of publishing an interdisciplinary paper was on the agenda at the very beginning of the project and how it was only years later that it was taken up again - this time in the shape of the material and methods article. Whereas this, to the junior researcher at least, seemed unambitious and haphazard, across the projects it appeared to be a common strategy in order to secure a shared article across a project.

Different ways of approaching the aim of a shared project article were discussed in most groups but the issue of organising and structuring an interdisciplinary writing process was something that for most project groups had been left to the individual researchers. An example of another way to approach interdisciplinary writing was in a project where the Co-PI took lead on the writing and handed out writing tasks to the other project colleagues.
One of the junior researchers, asked to write a section in this article commented on the process in the following way:

> It was a bit difficult in the beginning, because every one of us were actually doing different things. Of course we have a big cake, and then it seems like the way we entered were as individual pieces of that cake. I remember at the first meeting, we were mixed with other disciplines and were asked to define what is the project seen from your perspective. We are actually working in small clusters. And then we discussed one thing, and what do we actually see from different backgrounds that we can unite. I mean, we managed to produce one publication, which combined everyone (Interview, junior researcher)

The article aimed at demonstrating the range of perspectives around a shared research object; showing the different disciplinary perspectives on the object as the main outcome. In a further example, the writing was structured and driven by personal motivation. In this particular project the

project had worked on a concept article for the project research, but when the project leader was asked by Lindvig whether this had been part of an interdisciplinary publication strategy, and something he had demanded or orchestrated from the top, he laughed and said:

> No - I think it was more like a plan b - that if they didn't do it, then maybe I would go in and set up some strategic co-authorship. But really, what I have done is just to insist that I would only be stated as author on papers where I had actually done a substantial part of the writing, and you know, if you come from the natural sciences you will find that a bit odd, because as PI in these fields, your name is on everything. And another challenge is that this set up is not really that normal for the Social Sciences or Humanities either - but I just thought that this was a way to get people vested in the writing; that you wouldn't have all these passive senior researchers hovering on all the papers. (Interview, senior researcher)

The quote shows a willingness to let the output and results follow personal interest and initiative. What was published was a result of spontaneous drive from individual researchers who then gained something extra by taking on responsibility. This was an example of expectations aimed at the level of participation instead of expectations towards the outcome. While this was an example of expectations met and of a joint product, the call for interdisciplinary writing, we encountered, often comprised of large discrepancies between the intentions (expressed) and actual practices, ambitions, and intentions of publishing across disciplines were aired by the project managements, but in the interviews it was mentioned that that many of the younger researchers in the projects were in fact recommended not to write together and that their supervisors refused it, as comes through in this group discussion with junior researchers on interdisciplinary writing:

> R1: It would make NO sense, and you know if I have to be totally selfish and you have to be like that sometimes, it would make no sense.
> R2: And it doesn't matter where you'd like to go afterwards; if you want to work in the private sector or continue here, then that's just not something we are being measured on.
> Lindvig: But is it because it doesn't fit the journals?
> R3: It just doesn't count
> R2: yeah - but I still think that if you'd have to sit down and write together with someone else, then you would spend a lot of hours on it (R1: yes) compared to what you would get in return, I think.And I actually don't think we really ever had the choice. Of course we could choose (R1: no we didn't get the choice) to write it "Thursday after work" but it was really just shut down(...)

> R3: But I do think those types of articles will be written, I just don't think that it will be our time spent on it (R1: No it won't be our time) so I actually think it's the right decision the high-ups have taken that it is not for us to do. (Interview, junior researchers)

While the writing of articles across disciplines was a live topic in the interviews with PI's and junior researchers, the lack of time did not allow them to focus on these joint publications. Moreover, the lack of more structured support despite encouragement was mentioned by junior researchers as something that would hold them back from trying. The two junior researchers in the following quote find the environment they are in encouraging, yet express how they lack support:

> R1: I think they have encouraged us, but still, my supervisors are like 'remember that you will only succeed with this project, if you put yourself first' - like, 'remember what your aims or what your goals are for your own project and then you can kind of expand from there'
> R2: I feel like, I don't know how open they are, I mean I feel that they are very focused on writing together, whereas they have never really – it sounds really negative and I don't mean any negative about it – but I've never really felt like my input was solicited for anything, I mean they have written together. (Interview, junior researchers)

Though co-writing and publishing across disciplines was an articulated aim for the research projects, the actual framing and organisation was very much up to the individual researchers. Writing Interdisciplinary articles was seen as something on top of all the other practices in the projects. The core practices of writing and publishing were thus not adjusted to fit the interdisciplinary character of the research project. Instead, interdisciplinarity was squeezed into existing structures and frameworks or added to the to-do list of on-going practices. While some researchers used the conventional output formats from their respective discipline and fitted them to the joint task, others wanted to invent new ways of dealing with shared data and new methods were developed in the collaborative processes in trying to relate the various collected data and tell a new story about a shared research object.

Collaboration

With the focus on interdisciplinarity science has grown increasingly collaborative (Andersen 2016). In most calls for interdisciplinarity globally it is the collaboration of different disciplinary actors which are highlighted as crucial in terms of achieving 'innovation' and 'problem solving' of some of

society's complex problems (Lee & Bozeman, 2005). On a concrete level, internal collaboration at the university was highlighted as one of the three main focus areas in the University strategy 2016. In the Excellence Programme call, collaboration was also emphasised as a specific aim, based on the argument that 'such collaborations could be important and innovative facilitators for the exploration of societal, social and human challenges' (University of Copenhagen, 2012). The aim was thus put forward by the Pi's in the case projects. In each of the 5 case-projects, the various work packages involved researchers spanning across life sciences, social sciences and humanities. Following the daily practices in these groups, the organisation of collaboration was a central activity. In the following we explore some of the activities and products emanating from the call for collaboration.

The annual meetings and larger project gatherings were one of the ways to organise collaboration as a means to achieve interdisciplinarity. Often these gatherings would be organised as small conferences with all of the work packages presenting their research. A typical range of themes in an annual meeting program, taken from one of the projects, covered: 'Children's Rights and Food Marketing in the Digital Age', 'Infant formula feeding in Denmark and the US 1890-2000', 'Genetics of obesity and physical activity in children' and 'How Does Gastric Bypass Affect Eating Behaviour?' The presentations were thus often very different, detailed and specialised, leaving only a few discussants able to pose questions. As the student describes in the following quote, the joint meetings in the projects could feel a bit detached from the daily work and thus be difficult to understand the impact of.

> You know you collaborate interdisciplinary but you can still do your own research, and then suddenly you need to meet up, and have an interdisciplinary talk or meeting, and ehm, so – it can sometimes feel like you're just a guest, when your main work is something else and then you collaborate on a smaller project, and with other disciplines. We just had a young investigator network Monday, where we discussed a paper and it was very interesting to see when people from different fields, try to understand a different approach. How we actually do feel like, I guessed, in a different discipline. And, it's still like around the same topic but it's such a different approach that, yeah you just feel like you check in a hotel and then – go home afterwards but. You don't really leave any traces, or whatever, it's just come and go. (Interview, junior researcher)

Whereas this way of organising collaboration was common to the senior researchers in the projects, some of the junior researchers were less

experienced in talking with colleagues from a different discipline as in this excerpt taken from interview with a PhD student talking about a recent annual meeting held in the project:

> My recollection of interdisciplinarity was on an overnight course in the beginning of the project. It was really nice - that was where we kind of got to know the point of it all. Though, I didn't really see it as interdisciplinary. It was more about understanding the various parts of the project, so the Co-Pi's of the different groups presented their perspectives and contributions. You know, everything was explained. And there was just so much group work, and again - that is really not something we are good at 'and now you have to sit down and talk together'. And then you sat down and you were just sitting there. And you could clearly tell the natural scientists from the crowd - the scientists were the ones with the arms crossed, sceptically looking at the others [laughing]. I think actually, that is the only 'inter', you know - where kind of were in touch with the others. (Interview, junior researcher)

In the quote, student reflects on how interdisciplinarity was reflected in the project. The annual meeting with presentations of all the project researchers is something she recognises as interdisciplinary and also working in groups as she states represents this. But still she was not really able to assess it. The fact that she and her colleagues felt unaccustomed to group work testifies to interdisciplinarity as something estranged and residing in special features of collaboration, such as group work and in special occasions such as full day meetings with accommodation. This echoes findings from Repko and Szostak (2017, p. 222), of interdisciplinarity sometimes being used interchangeably with teamwork.

In the daily work of the researchers in the projects, shared ambition and dedication was central to collaboration. In one of the work packages, including researchers from both the social- and natural sciences, collaboration developed as the group of researchers searched for different ways of sharing the data produced in the project. A central idea concerned integration of all their data demanded that their data were comparable. This involved a lot of work on clarifying how each of the disciplines worked with data whether it was data in numbers or words and whether it was possible to align all data.

The group worked on the issue of obesity, with a focus on the multiple factors explaining the large variation of weight loss after bariatric surgery. The researchers had the ambition to share data and write together across their disciplines. To this end, the group developed an extensive excel chart, named the "hypothesis chart", in which all their various data collection units

and measures were gathered. Vast amounts of data ranging from measurements of ‘body composition’ and ‘food insecurity’ to ‘gut microbiota’ and ‘food addiction’ were included. One of the issues raised repeatedly in collaboration was how to accommodate all the methodologies of the disciplines involved. One way this was solved was agreeing to score ethnographic interviews into ‘ad hoc categories’ scalable in the statistical model, something not common to qualitative analysis, for example. The group told Hillersdal that choosing a statistical methodology enabled them to reach the aim of publishing in a high ranking journal. Meanwhile showcasing “the fully integrated data” was also a way to demonstrate their interdisciplinary collaboration. This echo studies of metadata used as a way to create interoperability and secure common ground (Edwards, Mayernik, Batcheller, Bowker, & Borgman, 2011). While statistical modelling in itself represents a specific type of complexity that can be conveyed in high-ranking journals, still, statistics were chosen as the common denominator despite the fact that several researchers in the group were not familiar with nor would have considered statistics as the most appropriate way of handling data - if working within their own discipline.

Collaboration was central to what both management and project colleagues thought of as interdisciplinarity. In the various projects, collaboration has been perceived equally as a means to reach interdisciplinary results and to meet the objectives of the Programme call. Across the projects, we have found collaboration to be bound in highly dynamic local practices which were not connected to any plans in terms of formalising it methodologically (reflecting findings from Jeffrey, 2003). Hence, the cases presented above were in fact not always creating collaboration nor interdisciplinarity.

Research based education

> To ensure and strengthen links between research and education, all applications for research initiatives must include a description of how the project will contribute to the education dimension (...) The educational dimension of research initiatives may include how students are involved in the research process or how the results apply to education in the form of courses and seminars etc.’ (UCPH 2016 funds call)

In addition to the aims of achieving new scientific discoveries, of reaching a high number of publications and of strengthening interdisciplinary collaboration, the Programme call also included a requirement to contribute to an educational dimension. The awarded projects were to create educational activities at bachelor’s and master’s level and to clarify the types of student-involvement in the projects (ref call). This was another

aspect distinguishing the Programme from other funding initiatives. Research foundations are usually not interested in supporting educational activities as they do not provide value for money in terms of research output (C. Lyall, 2013; Wichmann-Hansen & Herrmann, 2017). On the receiving end, the lack of support might become a problem if the money is given to projects and not centres, as the projects are difficult to align and embed in existing higher education structures.

In the Programme, the call for educational activities was driven by a wish to strengthen the linkages between research and education, and more specifically strengthen research-based education at UCPH. For the projects, the requirement resulted in a range of different products (see Lindvig et al 2017 for details): Across the five case-projects, bachelor's and master's students were to a higher degree than usual affiliated with the projects as they could count as research based education. In some of the projects, the bachelor's and master's students took part in the data production and the lab-work and used these data in the bachelor's and master's theses. In other projects, the students were enrolled as research-apprentices for 3-6 months, learning the craft of research while helping the researchers with their data-production and daily project management. There were also cases of students entering the projects as volunteers, with no official attachments. To the projects, student involvement became an asset as they added to the research and data-production with no-strings attached:

> To us the students are super important. No doubt about it. When we meet in the steering committee, we make fun of it but of course we all know that in reality we are completely dependent on them, well not only are we depending on them, when it comes to the research project, they are the ones deeply entrenched in the practical data work. So in that sense I think we all have a pretty strong idea of them playing the key roles in this. (Interview, senior researcher)

The fact that the educational activities were an official requirement, which could be evaluated, added a different goodwill to the students involved. It also created an incentive to showcase educational activities which might otherwise not have been linked to the projects.

In one of the projects, a summer-school had been planned from the outset and included a range of the researchers involved in the research project. While the summer school might have taken place regardless, it ended up assuming a more central position than anticipated due to the official

requirement. The setup was changed several times and the course-plan telling of what was perceived to be pressing and central issues of the research topic. And whereas the student evaluations showed limited signs of integration between the disciplines and the researchers present; to the researchers involved, it became an important validation and sign of belonging in the project.

In some of the other projects, summer-schools and courses served as means to educate and train the PhD-students affiliated with the projects. Whereas the educational elements were a requirement in the Programme, it also became a way to consolidate and strengthen collaboration in the research projects. A common thread running through these activities was, however, the limited repetitions. The courses and summer-schools arose once or twice and then disappeared. Securing long-term research-based education was thus not an outcome of the projects (Augsburg & Henry, 2009).

It is interesting to note that while the educational activities were not required to be interdisciplinary, as they served another purpose, they were in fact the activities supporting interdisciplinary effort the most in the research projects. Not because they were interdisciplinary; on the contrary, they were often perceived as the opposite by the students but because the course-planning promoted the sharing of methods, knowledge and ideas from the various disciplines involved. The development of educational activities made the researchers see value in other activities than expected and thus added different criteria to assess collaboration and the outcomes of the project.
While the type and amount of educational activities varied a lot from project to project, one listed activity, however, occurred in high numbers all the way through the projects. This was the number of PhD students affiliated to the projects. Counting as an educational element adds to the number of roles played by the PhD students in the projects: they were key-actors in writing and publishing across disciplines; they were active participants in various interdisciplinary collaborations, and finally they represented the primary educational element i the five case-projects. Perhaps not surprisingly, the many roles assigned to the students did create some confusion in the projects:

> Ehm, there isn't really a consensus around, or I mean it's different according to the different domains whether you believe interdisciplinarity should rest with the senior or junior level of researchers but I mean, everyone I hear from says that it is really important that the young researchers write a PhD

> within their own disciplines that will then be assessed based on the official regulations of their respective PhD schools. (Interview, senior researcher)

There was a double consideration at play for the PI's and the PhD-students involved in the projects: on one hand, the students had to finish and be recognised as proper PhDs within the official higher education system, as conveyed in the quote above. On the other hand, they also in some respects played the role as boundary spanners (Catherine Lyall, 2011) between the different work-packages and disciplines present in the projects, as they were the ones moving, physically, at least. The educational requirement thus created equal opportunities and dilemmas: it made it possible for the projects to enrol a larger amount of PhD students than they otherwise might have: On the other hand, they also had to treat the PhD students as students and not as workers, since the PI's did not have the final say over the PhD students, due to the institutional set-up of the projects (Lindvig, forthcoming). While this was frustrating for the PI's, as they did not to the same degree control the PhD students work, it also made for a confusing set up for the students:

> I probably should have integrated my fieldwork more clearly in the project, from the beginning, to sort of lay the foundations for interdisciplinarity; but again that really isn't my job, as a PhD student, being assessed as monodisciplinary and not as someone who is good at interdisciplinary collaboration - people don't give a shit about that. Because I will be assessed based on one discipline, I won't be assessed as an interdisciplinary researcher and neither will they, so of course it is of no interest to them - I mean what is the point? (Interview, junior researcher)

While the educational activities and the students were not assessed as interdisciplinary, they did, however, become part of the work of performing interdisciplinarity to external evaluators and critics of the project.

Evaluation

When the evaluation of the Programme was due - three years after the launch of the Programme - discussions of the evaluation criteria was made. These criteria had not been settled and especially the criteria for evaluating interdisciplinarity were unclear as the wording in the Danish and English Programme calls were so different. Meanwhile, it was clear that some sort of interdisciplinarity had to be evaluated (given the name of the Programme). Thus, in order to focus on interdisciplinary aspects together with monodisciplinary excellence, an additional member of the panel of otherwise monodisciplinary researchers was added. The agreed solution

was subsequently to add interdisciplinarity as bullet-points underneath the main aims in the self-evaluation, and then in the interviews and in assessing the self-reported evaluations 'look for synergy among the various researchers in the projects' (Bock et al., 2016). An example of this was as follows:

> 2.3 Publications
>
> Please list the five most important publications derived from the project to date and explain briefly why these are the most important publications. Please also describe the publication strategy of the project and publications in pipeline.
> Please enclose a list of the publications produced as a result of the project to date.
> - To what extent have you been able to publish interdisciplinarily within the project?
> - In what way, if any, has the interdisciplinary approach strengthened publications within the team?
> - What are the challenges and opportunities in relation to publication outputs? (Excerpt from self-reported evaluation template)

This wording meant that the projects were to primarily focus on their 'excellent' monodisciplinary work and then add reflections of the interdisciplinary research, publications, collaboration, respectively. When the evaluations of the 18 projects were over, a paper presenting the overall findings was written. In this, the panel stressed that

> [T]he mid-term review has not been based just on the excellence of the individual researchers involved in the projects but on an aggregated assessment of the interdisciplinary excellence of the clustered groups. In several instances, components of the funded project are outstanding and world-leading, while the consortium as a group still lacks integration. (Bock et al., 2016).

In the summary of findings made by the evaluation panel critique was voiced of lacking synergies (collaboration, exchange) between the different disciplines and research fields. This provoked discussions among the PI's in the projects as they felt they had lived up to the criteria of excellent research.

Evaluation was dealt with very superficially in the Excellence Programme. In the background paper and timeline of the project, the Programme evaluation was only mentioned in one sentence, as 'taking place after three years', thus not defined as a midterm or final evaluation. While evaluation

of interdisciplinary work in general is considered difficult (Boix Mansilla, 2006; Hackett in Weingart & Stehr, 2000a), the lack of concrete criteria left both leadership and project researchers unknowing of how the work involving interdisciplinarity would be assessed. The inertia in producing actual interdisciplinary products could therefore be seen as a result of the vague aims defining what was assessed in terms of interdisciplinarity. Instead, the norms guiding the practices became those of ticking boxes to render the projects accountable, rather than trying to explore or experiment with what might be products to evaluate upon.

As shown in the previous analysis the project assessment focus was on publishing, collaboration and educational development. What is evident from across our material is that the projects were preoccupied with meeting the agendas and goals, including interdisciplinarity, put forward in the call. As a result interdisciplinarity was invoked across all of the projects at annual gatherings and seminar as well at project meetings in the work packages; however, as we saw in the analysis, often in a superficial manner. As described in the section on publishing, 'interdisciplinary publication was on the agenda from the beginning of the project, however, was not prioritised until three years into the project. At this point, most of the staff working in the project had either ran out of funding, were about to defend their PhDs or move on to new projects. Choosing the materials and method article was a way to fit interdisciplinary writing into a conventional format rather than allocating time to reflect or develop strategies or methodologies for collaborative writing. In observing collaborative practices we found a similar lack of coordinated action and vision for developing and sustaining interdisciplinary efforts. People were brought together but without any intentions of securing the outcome of the collaborations. Those who by themselves tried to experiment with data integration and shared analysis neither received sufficient support by senior researchers nor had the competence within their own group to actually achieve what they had set out to do initially. Developing educational activities was fruitful but mostly in terms of 'educating' the researchers involved in the development. While the researchers found themselves reflecting and collaborating on what interdisciplinary education might entail and how it might be organised, this was not equally reflected in the teaching and for the students involved.

This continuous performativity and showcasing of interdisciplinarity also affected the role of the Scientific Advisory Board (SAB). Formally a SAB comprises a group of researchers appointed as critical and constructive advisors to a project. In the case projects the SABs were invited to participate in special events such as annual meetings or seminars. Asking

two project researchers about the role of their SAB in relation to interdisciplinarity, they said:

> R1: I have to admit that I really see interdisciplinarity as situated in our SAB, which we unfortunately are not using the way we ought to. You know, the board is meant to be supervising the project, helping us but that is not how we use them. We use it as a way of constantly seeking approval of what we are doing.
> R2: That's right and the SABs, of course they have all sorts of ideas, just like any other supervisor would, they also imagine things on behalf of the project, from the material we send them, and you know that's fine. But instead of creating a dialogue with them - you know, it's not like they have the power to fire anyone, and it is not in their interest either to punish anyone by giving bad reviews - but instead of having a dialogue with them, they are just being pandered to, in order to get these stupid positive reports.
> R1: It's just really difficult to maintain this narrative that you wish to pioneer Interdisciplinarity, when half of the project staff comes from the other side of the world, and are like 'hello my name is' and to whom this is a completely different reality, and also when you are not really interested in having this dialogue in the project. You are only really only interested in aligning with what the SAB is saying - something about the 'truth being interdisciplinary' whatever that means. That is what the managers of this project really would like to match, one way or another. (Interview, junior researchers)

Alluded to by the researcher in this quote, the SAB was assigned the role of 'authorising' interdisciplinarity. By effectively becoming an evaluating unit for interdisciplinarity, the roles as advisors and sounding board to the project management were downplayed. In interviews with SAB members this was also highlighted: some of the SAB members were elected because of their experience in interdisciplinary collaboration but often these competencies were not drawn upon sufficiently; rather the members experienced being used as 'figureheads securing interdisciplinarity without much action behind it'.

In this section we have attempted to unfold what the evaluation practices comprised of - practices that sought to underline, render or showcase interdisciplinarity. Furthermore, we have shown that the researchers involved in the program did not approach interdisciplinarity in the same ways nor did they have a shared vision of what interdisciplinarity might imply, which testifies to the multiplicity of needs and logics driving research

work (Barry & Born, 2013b; Barry, Born, & Weszkalnys, 2008). But the strategic push affected in all the projects that 'interdisciplinarity' (whatever that might be) was used to showcase that aims were met and goals achieved. The outcome of these evaluation practices was that interdisciplinarity as such was rather superficially and ill-defined in the projects but drawn forward to represent the project which in reality was not sustained within the daily practices in the research groups.

The point we want to make by addressing the evaluation procedure of the programme is how the lack of evaluation criteria affected the daily research practices. The pressure of unclear evaluation is powerful. Strathern compares auditing in academia to the panopticon in which every 'individual is acutely aware of their own conduct and performance is under constant scrutiny' (Strathern, 2000, p. 77). Poor research assessment has pervasive consequences both individually and institutional so noncompliance is not an option.

Discussion and concluding remarks

> Perhaps one reason why people do not talk much about making interdisciplinary objects accountable is precisely this - interdisciplinarity is itself an index of accountability: an evaluator rather than the subject of evaluation. I do not mean in any formal sense, but simply that it often serves in this capacity in people's thinking about projects. (Strathern, 2004, p. 79)

One of the most visible notions of interdisciplinarity at play in our study was the strategic understanding of interdisciplinarity, framed in policy statements such as 'integration of information, data, tools etc. to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or field of research practice' (National Academy, 2004) . This understanding of interdisciplinarity was underpinned and referred to in the official project settings: in applications, official meetings, evaluations and seminars. Although this notion of interdisciplinarity covers a wide range of forms and practices, through the policy statements, it is treated as though they were all one kind (Nersessian & Newstetter in Johri, 2014, p. 714). Tracing this kind of interdisciplinarity in our study led us down numerous blind alleys. Only a few informants (all at project management level) would confirm that the project had actually delivered products or involved practices responding to this strategic notion of interdisciplinarity. This view was confirmed in the midterm evaluation.. Looking through and across our study we see the effects of this strategic

understanding of interdisciplinarity is similar to what Suchmann (2013, p. 26) states as the weakness of plans. The understanding and focus on interdisciplinarity as a result of a strategy has systematically filtered out the particularity of detail that characterizes situated actions, in favour of those aspects of the actions that can be seen according to the plan (Suchman, 2013, p. 26). We argue that this lack of clarity in defining and evaluating interdisciplinarity became a way of organising research that produced a dominant but vague configuration of interdisciplinarity.

What became apparent was the overlap between the venues for showcasing interdisciplinary collaboration and for evaluations of the projects. The tension around evaluation meant that the projects were eager to perform or live up to criteria of interdisciplinarity which they could not know much about in detail. It created insecurity in the projects in terms of allocating time and resources, to try out new things and experiment because they could not be sure that the products they delivered would be assessable and able to qualify. Procedures of assessment have social consequences, as Strathern writes in her work on audit cultures in academia (Strathern, 2010, p. 2). Our case shows that procedures of assessment have wide ranging social and practical consequences also when they are merely present as *expectations* of being assessed.

The lack of clarity consolidated the existing monodisciplinary structures as something stable and safe in opposition to the new and interdisciplinary rather than boosting the interdisciplinary (echoing Augsburg & Henry, 2009; Weingart & Stehr, 2000a).The wording in the Danish call was ‘cross-cutting’ and ‘cross-faculty’ but translated into ‘interdisciplinary’ in the English version of the call which was then picked up by all projects funded by the programme. But as we have shown, the ‘unity’ of the concept of interdisciplinarity reduced the acknowledgement of the diversity of practises and products of the projects. It also created a norm of accountability which did not support initiatives that could not immediately be valued.

Our findings point to the general trait of large strategic projects to solve a range of tasks and interdisciplinary calls in particular seem to be ‘fuelled by competing and often contradictory sources and commitments’ (Weingart & Stehr, 2000b, p. 270). Whereas the various motivations behind the Programme, in addition to the size and scope of the Programme, does make the Programme exceptional, it however confirms the conglomerate of motivations and incentives driving research funding (Jasanoff, 2010; Nowotny, 2013) and how interdisciplinarity is used interchangeably with innovation (Weingart & Stehr, 2000b) to promote certain bureaucratic

strategy of creating administrative reforms in disciplinary based structures (Moran, 2006)

What has become clear when moving around in this field of study is that while objects of study related to interdisciplinarity might differ from one research field to another, and while interdisciplinary efforts and practices might be isolated, scrutinised and analysed very differently from field to field - the mundane practices of interdisciplinarity cannot meaningfully be understood isolated from the strategic frame, in which it is created. If the overall framing of interdisciplinarity is unclear, then the practices at the ground levels of research will reflect this, thus creating window-dressed, unified interdisciplinary performances of interdisciplinarity and (un)intentionally reproducing the monodisciplinary structures and products.

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4

CONCLUDING DISCUSSION

Concluding discussion

This is the final part of the thesis and thus the part where I address the results of the PhD project. I begin by answering my research questions and then move on to addressing additional findings and what questions this PhD project give rise to.

Research questions and answers

What are the linkages between interdisciplinary research and education?

A response to this is that educational activities arise from interdisciplinary research in different ways. The researchers in the research projects frequently taught classes and courses in established monodisciplinary educational programmes where, occasionally, they would draw on cases or findings from the projects. While these activities were ongoing and part of established structures, the designated interdisciplinary educational activities were placed outside as add-ons to the established programmes and structures. Whenever interdisciplinary elective courses and summer schools were created, they would only run once or twice and not be imbedded as part of the standard courses offered by the university. Furthermore, the interdisciplinary activities appeared to be more in the making and student driven than the monodisciplinary activities. Whereas the research presented in the monodisciplinary programmes and courses would be finished and presented as cases, the interdisciplinary activities - many of them driven by the students - would be based on, and sometimes even contributing to, research in the making.

Following this question, I wished to explore ***how the interdisciplinary educational activities were created and how the various researchers negotiated what content should be included*****.** I did, however, not experience many negotiations. I followed a few courses from the beginning to the end and there it was not as much a matter of negotiations as it was an art of the possible: who could teach the modules, when and what would create the coherence between the disciplines and subjects represented? If the coherence was created by the course planner linking the components, there would be little negotiation as this person either took on (or was left with) the task to create coherence between the elements. In the activities driven by the bachelor's and master's students, they were in charge, inasmuch as they were the ones moving and doing the work. As for the PhD students, they were either adhering to the planned PhD projects or

following the guidelines from their home departments, at the cost of sometimes disappointing the project PIs.

As to the question of ***roles assigned in planning interdisciplinary activities,*** the various faculty and the students took on different roles in the collaboration and planning. Whereas the faculty would plan interdisciplinary activities such as summer schools and elective courses, the bachelor's and master's students would practice interdisciplinarity by getting involved in the research processes, taking courses at other faculties, becoming apprentices in the research projects or writing their theses based on data from the projects. While the bachelor's, master's and to some degree also the PhD students were the ones practicing the most integrated types of interdisciplinarity, they were also the ones verbally addressing it the least, thus making it difficult to detect. This leads me to the final research question, and to ***the relation between the intentions behind the educational elements and the final results****:*

When looking at the individual activities in the case projects, the differences between intentions and results were primarily due to issues of integrating various monodisciplinary elements, aligning expectations of the monodisciplinary external examiners, changes in the student population attending the course, and due to administrative challenges. Furthermore, the plans would change due to availability of faculty teaching, of rules regarding ECTS credits and examination. While some of these issues were related to the interdisciplinary aspects of the activities, they were for the most part reflecting general issues of planning and executing educational activities. This point towards the use of interdisciplinarity as tracer or intensifier of more general issues, challenges, mess, serendipity and chance involved in creating educational activities (Goodson & Ball, 2012; MacLure, 2006a).

Meanwhile, as is also unfolded in paper II, the variations between intended and realised activities in the five projects were not as pronounced in the individual activities, as they were in the overall execution of activities. Comparing the applications and the mid-term evaluations of the 18 research projects in the Excellence Programme, a clear increase in activities was found (as described in paper II). Additionally, the interviews with faculty and PhD students pointed towards a range of activities not documented officially. Hence, while the aim of posing this research question was to learn more about the local levels of planning and carry out interdisciplinary educational activities, the question instead pointed towards the structural and institutional levels of interdisciplinarity. A further reply to the question of variations between intended and realised activities is thus

that interdisciplinary educational activities thrive in the interstices of monodisciplinary structures, and are - though not permanently embedded in the structures - changing and affecting the institutional structures and the students participating.

Details and detours

As stated in the beginning of the thesis, my motivation for embarking on this PhD project was to explore interdisciplinarity in the making; to see the processes and negotiations that are not visible in the official presentations, assessments and evaluations of educational activities such as courses and programmes. As part of a development project with the objective of improving interdisciplinary teaching and learning at UCPH, a natural emphasis was put on the practical, hands-on levels of planning and teaching. However; I was simply not able to answer my research questions in as much details as expected.

I chose to do fieldwork in five projects, as I wanted breadth and variation in my findings, but also because I wished to follow projects with various ambitions in creating educational activities. I was therefore left with less time to follow each individual project. This may have caused me to overlook activities, and prevented me from following the identified activities more close.

Another issue affecting the final outcome was the object of study. Creating interdisciplinary educational activities within a monodisciplinary institution was a first for many of the faculty and students involved. This made it difficult to map reoccurring practices, as there for many of the participants was a real sense of trial and error involved. As discussed in paper IV, the lack of clarity in the overall aims and evaluation criteria also affected the activities created. Finally, the lack of institutional structures supporting interdisciplinary activities sometimes led to activities driven more by serendipity, coincidence and personal interests, than structured planning.

Despite these circumstances, the advantages by far outnumber the disadvantages. Following the five projects gave me access to PI's, faculty and students involved in very different fields of research and placed in very different settings. This added contrasting perceptions of interdisciplinarity and various approaches on creating interdisciplinary activities to my study. Choosing five different cases has thus provided perspectives and viewpoints that wouldn't have been visible with just one case. Furthermore; following such different projects in such a distinct programme has shed light on issues that would be difficult to trace in institutions that from the outset were made to accommodate interdisciplinarity. The study has enabled

other discussions than those of clear cut problems and cleaned solutions, which was also an aim from the outset. In the words of MacLure, it has been a study adding emphasis to education's other.

Thus, the conditions for the PhD project might have limited the level of detail in answering my initial research questions. They have, however, enabled additional findings and provided me with further insights, which I will expand upon in the next section.

The voices of interdisciplinarity

> As a university, we need to speak with two voices: We need to indicate to the public that what we are doing is solving society's grand challenges; that we have the answers and solutions to their problems. But we also need to carry on with our research and be excellent in what we do. (Field notes, annual meeting in the Excellence Programme)

This statement was put forward by the university management at the final Programme meeting. It was a response to criticism voiced by the project PIs that the university management had not sufficiently ensured the imbedding of the interdisciplinary projects at the university, when the funding period was ended. The response could be understood in various ways: It could be a way to underline the obligations a university has, and in this underlining that in order to solve societal problems, the university needs to dig into monodisciplinary fields and be excellent at that. As the PIs at the meeting emphasised the importance in continuously supporting the interdisciplinary research at the ground levels, the statement could also be interpreted as if the management instead considered interdisciplinarity to be more of a branding strategy. Even though it is not possible based on the quote alone to interpret the intended meaning of the response, I choose to include it because the two voices stated were present throughout my fieldwork in the Excellence Programme: On the one hand, interdisciplinarity was called out and mobilised as a strategic concept; as a way to communicate with the public and potential future funding bodies and address societal challenges. On the other hand, it was a mundane practice reflected in the everyday work of the researchers, and of the students involved in the research projects.

While these two voices have mostly been discussed separately in the four previous papers (and in the literature in general), the aim of this concluding discussion is to get a hold of them together; to discuss how they relate to one another, what they produce and with what effects.

Mobilising and practising interdisciplinarity

At the annual meetings in the Programme and in the individual projects, interdisciplinarity was named a collaborative effort, resting on a strong monodisciplinary foundation, but not necessarily defined any further. At these meetings, the terms multi-, cross-, inter- and transdisciplinarity were used randomly, without ever being distinguished from each other. Additionally, in the Danish and English calls for applications for the Excellence Programme, different wording was used to name activities cutting across faculties and disciplines (see paper IV). Finally, interdisciplinarity was never evaluated based on set definitions or criteria in the programme. Instead, the evaluation panel looked for 'synergies' in the projects. The multiple uses and the ways of applying terms not only impacted on the PI's management of the projects and the evaluation of the projects; it also affected the mundane levels of research in the projects, as shown in paper IV.

These described ways of applying but not defining interdisciplinarity echo findings from the literature, where a similar use of interdisciplinarity was identified in the 5th (EU) Framework programme (Bruce et al., 2004) and in several other large scale funding programmes (Lyall, Bruce, Marsden, & Meagher, 2013; Hackett in Stehr & Weingart, 2000; Strathern, 2004). The strategic use of interdisciplinarity has also been claimed (Barry & Born, 2013; Stehr & Weingart, 2000) to result in a unity of interdisciplinarity and as Callard and Fitzgerald (2015) state:

> What follows springs from our deep dissatisfaction with much of what passes as 'interdisciplinarity' – both in theory and practice.(...) Along the way, we have become increasingly irritated with the normative weight that that this prefix – inter- – has come to carry. A kind of transgression is apparently achieved by working between one discipline and another – and yet fundamental assumptions (e.g. about what an experiment might be, about who does it, about how its objects are produced, and so on) are left quite unquestioned (Callard & Fitzgerald, 2015, p. 4).

In this quote, Callard and Fitzgerald address the disparity between the extensive uses of the concept interdisciplinarity and the lack of clarification or of addressing the fundamental assumptions. These fundamental assumptions of the mundane practices of interdisciplinary collaboration and research were the focus in paper IV. Through the field work it became clear that a multiplicity of interdisciplinary practices were taking place at the local levels of research, education and collaboration. However, as described before, these interdisciplinary practices often took place in quiet; the PhD students didn't address their mundane work at the departments as

interdisciplinary, though this entailed writing and integrating data and knowledge across disciplines; the bachelor's and master's student would participate in research projects and write their theses in one discipline with material from another, collaborating with a student from a third. Yet, this was not called out as interdisciplinary. Finally, the faculty would plan courses that dealt with cross cutting issues, teach students with a variety of disciplinary background, and still not address it as interdisciplinary.

As described in the literature chapter of this thesis, the ways to approach interdisciplinarity can roughly be divided into categories of integration and generalisation; of perceiving interdisciplinarity as something that can and should be defined by concrete, set methods and guidelines (Repko & Szostak, 2017) or as something which basically relates to any dialogue between disciplines (Moran, 2010). Because of these different approaches to the term, the use and purpose of interdisciplinarity have also been perceived and translated differently. One the one hand, interdisciplinarity has been pushed forward in larger funding schemes as the way to solve wicked problems (Ledford, 2015) and grand challenges (National Academy, 2004); as a mission for insurgency (Klein, 2010, p. 123) that disrupts conventional ways of doing research; and as a term carrying the connotation of being dynamic, flexible, liberal and innovative (Stehr & Weingart, 2000, p. 29). On the other hand, it has been the topic of numerous books and articles, where it is used as a specific way of defining certain practices of research, education and collaboration (e.g. Davis, 1995; Klein, 1996; Lyall, 2011; Newell, 1994; O'Rourke, Crowley, Eigenbrode, & Wulfhorst, 2013; Repko & Szostak, 2017).

These ways of approaching interdisciplinarity have so far mainly been divided and treated individually in the literature; partly because of a division of labour between research fields studying interdisciplinary research, collaboration and education, respectively; partly because the approaches address different levels of higher education and research and do it out of different reasons. Nevertheless, in my fieldwork they have been concurrently present; as two voices, speaking at different sound levels. The loud and strategic voice has been present at the Programme and project management levels; the more quiet voice of practicing interdisciplinarity has been present at the mundane levels, among the faculty, researchers and students in the projects.

Hearing these two voices at the same time has created noise that in some ways disabled my initial intentions and research questions. Listening to the two voices in concert did, however, provide me with additional perspectives. By disentangling the two voices and trying to understand

them individually, it became possible to see connections between them and also see what causes the confusion around the concept of interdisciplinarity.

Having the two voices present in one field has revealed how important it is to ground strategic concepts in practice and adjust them to fit the local context. Hence, if the university management had defined the aims and ambitions with the Excellence Programme more clearly - maybe by explaining how they defined interdisciplinarity and hence also how they were evaluating and assessing it - lots of time and effort would have been saved by the research projects. The faculty would not have had to *perform* crosscutting collaboration, state intentions of publishing interdisciplinary papers (see paper IV) and the students might have avoided the feelings of being handcuffed to their disciplines (as was described in paper III).

The voices did, however, also reveal how local practices of interdisciplinarity take place without ever applying the definitions of interdisciplinarity; how courses that were highly integrating and students that cut across various disciplines during their masters' and PhD studies did so without even considering it interdisciplinary (see paper II and III). This is comforting for those who find interdisciplinarity in higher education important. But it is unfortunate for those, who would like to learn from examples and previous experiences in creating interdisciplinarity.

Based on a literature study of empirically based, international, peer reviewed articled on interdisciplinary teaching practices; based on the study of interdisciplinary educational activities within monodisciplinary structures and based on the general fieldwork in the Excellence Programme of Interdisciplinary Research at University of Copenhagen, I will conclude the following:

The concept of Interdisciplinarity has a loud and performative voice and a quiet and productive voice. Whereas the performative voice is visible in strategies and funding talks, the quiet voice is present at local and mundane levels, where students and researchers do highly integrated research and educational activities. The question is whether these two voices support or impede each other? I believe they do both. The quiet voice needs the attention that the loud voice creates. The loud and strategic application of interdisciplinarity to research programmes has enabled research and educational programmes that would otherwise not have been funded. Nevertheless, the loud voice needs to be grounded in examples and cases such as the ones provided by the quiet voice. Too

much research and too many educational activities have invented the wheel due to the lack of shared knowledge and research.

We therefore need to make distinctions between the two voices, but realise that they are both there. Perhaps the very loud voice would benefit from being lowered a bit, by addressing concrete, situated aims and arguments for interdisciplinarity, instead of continuously harping on the same string of global challenges and wicked problems. This could perhaps prevent the deflated and unified perception of interdisciplinarity. Perhaps the quiet voice could gain from a wider distribution of knowledge of interdisciplinary research, education and collaboration. While blogs, compendiums, institutional websites and books in various languages do provide a knowledge base on interdisciplinary practices, in order for it to achieve international reach, it needs to get into the internationally recognised literature. Perhaps then, what has so far seemed more as a competition between different uses of interdisciplinarity, could instead become a conversation?

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APPENDIX

Co-Navigator set to be used at University of Maryland

Interdisciplinary Tool Helps Fast-Track Interdisciplinary Learning and Collaboration

By Katrine Lindvig & Line Hillersdal, University of Copenhagen
David Earle, Braintrust

CoNavigator began as an interactive introduction for an interdisciplinary graduate course at the University of Copenhagen and is currently being developed as a tool for interdisciplinary courses in general – building on knowledge and experience from our research on interdisciplinary learning and collaboration. As a spinoff from the presentation of the tool at the AIS conference in Ottawa, hopefully, come fall, the tool will be part of the curriculum in undergraduate courses at University of Maryland, Baltimore County.

Mobilizing interdisciplinarity in monodisciplinary structures. The University of Copenhagen (UCPH) is a traditional European faculty-structured university with a strong monodisciplinary subject-based framing, leaving little room for interdisciplinary teaching and learning. Nonetheless, the university offers an increasing number of interdisciplinary courses and programmes, which reflects the political mobilization of interdisciplinarity oriented towards solving problems which cannot be solved by "one discipline alone."

This mobilization has, in a Danish and European context, led to large funding initiatives directed towards interdisciplinary research projects. In turn, this has caused a push towards more interdisciplinary educational activities.

In a monodisciplinary UCPH setting, creating interdisciplinary activities has therefore often been an art of the possible and resulted in one-off events that appear as various disciplines "glued" together by a common theme or a joint problem. In other words, the political mobilization has promoted the production of interdisciplinary activities but not necessarily enough to secure proper embedding or pedagogical cohesion.

How it all began. Our collaboration – and essentially the tool CoNavigator – is a very direct result of one such politically mobilized project, namely an interdisciplinary research project called "Governing Obesity." In this project Hillersdal, as a social anthropologist, was exploring how politically mobilized interdisciplinarity was translated into practice. Lindvig was simultaneously studying the ways in which this interdisciplinary research project translated their research into educational activities (e.g., PhD programmes, undergraduate courses, summer schools). At the end of a two-year field study on these educational activities, Lindvig was approached by one of the course administrators and asked to step in and contribute to a summer school arranged by the research project. In order to make this happen, Lindvig teamed up with Hillersdal and Earle, who as a partner at the think tank Braintrust, was used to creating and developing interdisciplinary tools and processes.

We were invited to present the concept of interdisciplinarity to the students attending the two-week summer school. The tool we developed was inspired by a more lengthy workshop format (Braintrust Labs). The idea was to boil the format down, from two days to just three hours, adding our knowledge and experience on interdisciplinary teaching and collaboration and thereby changing it into something that could be implemented in an interdisciplinary course. This required it to be easy to explain to students coming from all types of disciplines and backgrounds. Furthermore, it had to create links between modules which had already been put in place, and a range of faculties at different levels of teaching.

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Co-Navigator

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Developing the Tool. Often the way to approach interdisciplinary learning and collaboration is to first find a common/joint topic to collaborate on and then set up the issues one might want to address. In this case, the topic and issues were already decided. The theme given was obesity and governing the issues related to the growing challenges of an obese population. While the students knew about the topic and issues, they did not know how their discipline and skills matched the other disciplines and skills present, nor even how their discipline and skills might be perceived by the others.

"How can we communicate across disciplinary and methodological divides without compromising, reducing or oversimplifying our research and without losing face or academic identity?" This was one of the questions that drove our collaboration. It stems from previous experience of facilitating and collaborating with other disciplines and the ways in which implicit politics of knowledge act as barriers. The grounded ideas of each discipline end up taking center stage – to the point where the parties involved are left as mere disciplinary representatives – and not as active collaborators. Furthermore, we saw a tendency to move as quickly as possible to finding solutions to complex problems, without first exploring the complex interdisciplinary connections and roles, or understanding the interdisciplinary 'landscape' of a given topic. In this sense, the tool addresses a problem which the participants tend not to think exists, that already is covered by the agreement to collaborate. With this tool, we have therefore tried to make tangible the assumptions, prejudices and knowledge from each present participant – synchronizing maps and expectations and even the meaning of the concept "expectations".

Overall, the tool encompasses three steps:

CoNavigator is a methodological tool which allows groups to collaborate on a 3-dimensional visualization of the interdisciplinary topography of a given field or theme. They can then explore possible connections between diverse areas and demonstrate how their own competencies could reinforce or drive new connections. (Photo provided.)

1. Making the Tacit Visible and Tangible. The first task of the newly formed group is the making of a Tool swatch by sharing one's own and others' competences through short interviews. By explaining their skills to a person with a completely different background, the interviewee is forced to re-evaluate, re-formulate, and translate skills in a way that increases their own disciplinary awareness. And by using open-ended questions such as 'What', 'Who', 'How', and 'Why', the interviewer gets the interviewee to not only draw from his or her usual disciplinary vocabulary, but to unfold and explain what, for instance, 'action research' or 'regression analysis' means in practice, and how it can be used.

Each competency that is identified is written onto a separate Tool Swatch, and each participant then 'presents' the competencies of the person they have interviewed to the rest of the group. This approach allows for a practical and situated approach to what disciplinary competence is. The participants define positively the competencies and experiences they have without having to represent ideal versions of their respective disciplines. Following this, the participants then begin the creation of elements to go in the joint map.

Each participant is encouraged to identify the key areas of the map from their perspective, rather than be initially influenced by the viewpoints of others within the group. Each point is written (or drawn) onto a single tile. Rather than specifying challenges and problems, participants are encouraged to identify themes and interests, so as not to direct or narrow down the scope too early in the process.

2. Negotiating and Organizing a Context . Once the individual tiles are created (as many as are needed), the group must negotiate how each tile will be positioned within the collaborative map. During the negotiation

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phase, the participants stand up with all chairs pulled away from the table so they can freely move around and arrange the tiles together.

During this process the tiles begin to cluster into small or bigger areas, reflecting the specific interests of the group. The crucial element in this step is how the participants negotiate with each other – there is never just one right way to create and plan the topography of the map. Also - the individual tiles of the participant may very well carry themes, points and interests that are very different in terms of details and coverage, which must then also be taken into consideration when constructing the joint map.

This phase of the CoNavigator tool resembles other mapping exercises already existing in the field, however, one difference is the emphasis on themes and areas to be explored and navigated instead of problems to be solved. When we did the testing of the tool, we found that an orientation around the problem created divides on the map (between stated problems and stated solutions), which narrowed down the scope and eventually also created divides and discussions among the participants that we found were not particularly fruitful at this stage.

3. Infrastructuring. The last step of the tool is about "infrastructuring" new routes on the co-developed contextual mosaic. The infrastructuring process challenges the players to connect to and navigate through themes and interests of the other players. The more links the better.

The new infrastructures created are then related to each participant's individual Tool swatch developed at the beginning of the game. Each player then assesses where and how singular competencies can be used to deal with the newly developed infrastructure.

An important point at this stage is to keep the participants in the process and to let them explore connections and arguments which are open-ended, instead of leading them towards a common goal, project or solution.

Though it is tempting to finish off the process with a final conclusion/solution, the crucial thing is to stay with the diversity of the created map. Furthermore, if the tool is part of a longer interdisciplinary process (e.g., a course), large format posters can be made from photos of the finished construction. Revisiting it later on in the course can lead to new insights.

Inspiration and acknowledgements. In the process of developing this tool we have been greatly inspired by the idea of a Visual Lingua Franca, defined as visual languages systematically used to make communication possible between people not sharing the same mother tongue.

In the process, we have also drawn on works by Repko, Szostak, Newell and Klein, the Interdisciplinary studies project, Ground Zero as well as the td-net's toolbox to name only a few. Furthermore a number of students and groups of colleagues have helped us test the tool in various rounds (a special thanks to the Edinburgh team including Catherine Lyall and Laura Meagher).

What the future holds. At the AIS conference in Ottawa, we presented the tool in a shared a session with a group from Baltimore, led by undergraduate student Maniraj Jeyaraju. He and his colleagues Eric Brown, Stephen Freeland and Steven McAlpine all inspired us and shared our interest

The tactile nature of the tool is designed to encourage collaboration and negotiation, while the writable tiles and connectable cubes enable rapid, collaborative visualization. The topographies are easy to photograph for later use, while each participant takes with them their individual "tool-swatch", which can help them to identify and contextualize their role in future collaborations. (Photo provided.)

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Book Announcement

Ordinary Wars: Doing Transdisciplinary Research

By Genevieve Durham DeCesaro and Elizabeth A. Sharp

Transdisciplinary projects are messy, complicated, and exhilarating. They stretch collaborators, sometimes uncomfortably, beyond the predictable, expected, and routine. Making public the private tensions of "ordinary" cultural expectations associated with singlehood, marriage, and motherhood, the authors used a kinesthetic analysis of social-science qualitative data to create an evening-length professional dance concert.

Ordinary Wars: Doing Transdisciplinary Research is an exploration of the project, from its inception through its current state. It focuses on providing readers with an understanding of the ways in which working collaboratively on a transdisciplinary project is both incredibly challenging and unpredictably rewarding. Readers are invited "backstage" as we expose our discomfort, missteps, confusion, successes, and lessons learned. We argue that transdisciplinary research is a vehicle for affecting transformative, cultural change.

ISBN: 978-1-61229-843-6 • 106 pages

Genevieve Durham DeCesaro is Vice Provost for Academic Affairs and Associate Professor of Dance at Texas Tech University. Her choreography has been commissioned nationally, with notable presentation at the John F. Kennedy Center for the Performing Arts. She maintains an active performance career and researches across areas related to feminism in dance.

Elizabeth Sharp is an Associate Professor of Human Development and Family Studies and an affiliate faculty member of Women's Studies at Texas Tech University and held an Honorary Fellowship at the Institute of Advanced Study, Durham University, England. She has published in Human Development and Family Studies, Sociology, Psychology, and Family Therapy.

Co-Navigator

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in developing interactive methodologies and games for interdisciplinary learning. They showed an interest for the tool and, as a direct spinoff from this meeting, we have now started collaborating with the aim of introducing the tool at University of Maryland, Baltimore County (UMBC) this fall. This is something we really look forward to and we believe fits fully within the goals and aspirations of the annual AIS conference itself.

Broken into three incremental steps, each participant starts by putting their own discipline, competencies and skills into context with the others. They then build a 3-dimensional topography which enables participants to collaborate around a joint topic. After isolating specific interest nodes, they can then explore and negotiate potential connections between the nodes, and suggest how their own competencies could strengthen or build the connections. (Photo provided.)

Katrine Lindvig (b. Denmark), is a PhD research fellow at the Department of Science Education, University of Copenhagen (UCPH). In her dissertation she studies the linkages between interdisciplinary research and interdisciplinary teaching practices through an ethnographic case study of five large interdisciplinary research projects at UCPH.

Line Hillersdal (b. Denmark), is a social anthropologist working on eating, obesity and cultures of science. She currently holds a postdoctoral position at UCPH in a project on interdisciplinarity and obesity science, where she studies how obesity as an object of intervention emerge in interdisciplinary collaborations intertwined with technologies, people, and values in practice.

David Earle (b. Ireland), is a partner and visual consultant at Braintrust – a think tank based in Denmark – since 2012. David has focused on developing visual and tactile tools and methods to help students learn to navigate through their academic knowledge, and to work more effectively in multi- and interdisciplinary teams.

Key findings from development project ‘Interdisciplinary education at UCPH

1. Any interdisciplinary education / teaching must be closely linked to an interdisciplinary research environment. If the education is offered from research communities that are separate from each other, it is crucial that they also build cross-cutting research activities that can support the education.

2. Teachers from a mono-disciplinary culture must be offered support functions when they are to participate in interdisciplinary education / teaching. There is a need for pedagogical didactic continuing education focusing on teaching methods that support coherence. Teachers with different academic backgrounds must become aware of communicating across disciplines.

3. It is not always clear for students from mono-disciplinary how interdisciplinary education contributes to their professional development, i.e. they do not see the relevance or need for interdisciplinary learning. They often lack interdisciplinary communication skills.

4. Interdisciplinary teaching and education can be many different things, and different forms of interdisciplinarity may be relevant depending on the purpose. It is important to declare what kind of interdisciplinarity it is and what the purpose is, so expectations can be reconciled.

5. In order to ensure continuous development of interdisciplinary education, it is crucial to involve the students. The students are often innovators and play a particular role in developing the interdisciplinary aspect of the programs.

6. It is important for organizational embedding of acquired experience and understanding of interdisciplinary skills. The department will build up knowledge and resources that can ensure good conditions for interdisciplinary education and the development of interdisciplinary education. This implies that the experience gained with interdisciplinary education is collected and widely systematically. This can happen, for example, by the educational centers having special resource subjects for interdisciplinary skills.

7. The administrative framework must be able to support interdisciplinary education. Interdisciplinary teaching is for example administratively associated with the use of significant resources, including meeting activity, examination rules, curricula, and to harmonize with different faculty budget models.