1 Introduction

Interdisciplinary[1] work is to a large extent a question of entering the unknown, an adventure with exciting and endless opportunities. Since each setting is new and the details cannot be foreseen, students and scholars who work in interdisciplinary environments must be independent and self-driven. This book is therefore more of a guide than a how-to handbook. "High quality" is shaped differently in different disciplines. Rather than letting these differences be a hindrance, you can use them as a springboard for inventive and original work. The governing idea of this book is to facilitate creation of interdisciplinary work by stimulating dialogues on quality and to draw on common-ground-creation processes to find unknown and unexplored territories.

This is first and foremost a book for graduate and undergraduate students about to enter the interdisciplinary world, but my intention is to write a book that also is useful for teachers, supervisors, researchers and editors who are active in interdisciplinary settings.

Drawing on my own experiences and leaning on the literature on interdisciplinarity, I strive to facilitate the development of "Reflective Doers".[2] The target is mainly students and scholars in the environmental field, who work with issues that involve interaction between and among the human and natural worlds and who consequently may have quite diverse disciplinary backgrounds – spanning from natural sciences, technology and health sciences to the social sciences and not least the humanities.

I strive to use a simple language and as far as possible avoid jargon and specialist terminology. Things that are self-evident for a physicist are alien to an anthropologist and vice versa. For example, a colleague who read an early version of the manuscript asked why I do not use the terms nominal, ordinal, interval and ratio data. The reason I avoid these

terms is that even though they are basic knowledge for someone with a background in mathematics or physics, they are impenetrable jargon for everyone else, who consequently would be excluded from the text. So, if you feel that my text occasionally is simplistic, it is likely because I avoid or tread carefully when using terms that to my knowledge are ambiguous in interdisciplinary contexts, common knowledge to you but Kiswahili to someone else.

Now and then I touch upon subjects that are discussed at length in other forums. I try to highlight when I touch upon such fields and in the footnotes I suggest some readings, but I will not engage in these ongoing debates, as it would lead too far from the aim of this book.

In Chapter 2, I delve on "The Gap" between humanities and social sciences on the one hand and natural sciences, technology and medicine on the other. The focus lies on real and perceived gaps that often cause problems and how they may be approached to enable creation of common ground. In Chapter 3, I present a framework that is designed to facilitate the creation of high-quality interdisciplinary work. A key aim of this framework is to empower you to identify, accept, respect and draw upon disciplinary-based cultural differences; in other words, to help you find ways to *use* the differences. In contrast, if you are unaware of the differences among the academic cultures you encounter, it is likely that they will impede your work. The framework illuminates three dimensions of interdisciplinary quality:

1) integration of elements from different disciplines.
2) interaction with organizations and individuals outside academia.
3) rigour from an academic point of view.

In Chapter 4, I discuss the first part of the framework: specific demands on different types of interdisciplinary work with a focus on disciplinary boundaries within academia. Chapter 5 focuses on the second part of the framework: boundaries between society and academia.[3] In Chapters 6 to 11, I dive into the sub-components of the third part of the framework: academic rigour. These components are valid for anyone conducting academic work and this part of the framework thus applies to disciplinary as well as interdisciplinary environments. While disciplinary students may learn how to conduct rigorous studies through apprenticeship rather than through conscious analysis and reflection, interdisciplinary scholars need to address these issues consciously and explicitly – since beauty comes in many forms. In Chapter 12, finally I discuss quality assessment in light of the rest of the book and how hierarchies in academia, as well as arrogance and snobbishness, hinder collaboration.

Challenges and opportunities

To become a student in an interdisciplinary context can be confusing. Students and scholars who are active in a disciplinary environment use that context as a springboard when they plan a study, collect data, analyse, read and write. It is as a rule more challenging to work in an interdisciplinary environment, since such settings often embrace differing and in some respects incommensurable academic cultures.[4]

To draw on the strength of interdisciplinary work you need to manage differences among academic cultures. If you work with extra-academic partners, you also need to manage differences between academia and society. A well-known route to success is to create a climate that stimulates awareness of interdisciplinary opportunities, not least as it will help you to identify your own viewpoints and limitations.[5]

There is a large and growing body of literature on interdisciplinary work.[6] This literature is, unfortunately, not of much help to the newcomer. In general, the focus of this literature is on challenges, barriers and problems, which easily could give you the impression that interdisciplinarity is a "mission impossible". As has been pointed out by Lattuca (2001), the literature on interdisciplinary study offers "a litany of geopolitical metaphors /.../ that creates the impression that academic disciplines are foreign territories and interdisciplinarians, hapless trespassers" (p. 243). Research on interdisciplinary studies is both a large and emerging research field, with its own theories and jargon. The literature is mainly written for and read by those who conduct studies on interdisciplinary work. Paradoxically, one might even say that the field has developed into a discipline firmly situated in the humanities. We, those conducting interdisciplinary work, are (as described in the literature) busy in our own research fields, reading literature, participating in conferences and the like. It is unrealistic to expect that any newcomer has the capacity to be in the forefront of his or her (new or emerging) field of study and at the same time be literate in research on interdisciplinary studies. As pointed out by many before me, an easy-to-read guidebook is desperately needed. However, previous attempts speak more to those studying interdisciplinary work than to those doing it. My audience is those who conduct interdisciplinary work and even though I avoid the insider jargon, I draw heavily on the literature as many of the findings undeniably are extremely helpful for the "doer".

One thing that we learn from the literature is that interdisciplinary work is nothing new and successful interdisciplinary studies have been conducted for as long as disciplinary studies.[7] There have always been scholars and students who challenge and cross traditional boundaries. Highly successful interdisciplinary projects have constantly been carried out and many claim

that the most exciting and cutting-edge studies have always been born in such settings. It is true that the literature dwells on the difficulties of interdisciplinarity, but the literature also shows that it certainly is not a mission impossible. On the contrary, interdisciplinary studies hold tremendous opportunities.

On quality

The crux of successful interdisciplinary work is to acknowledge that the basis for judging quality varies among disciplines.[8] Quality is to a large extent achieved by adhering to agreed norms on how things should be done – norms that are handed on by traditions. A number of explicit and implicit norms lie beneath each and every discipline and these norms are, to a considerable extent, mirrored in the text. What is to be told, how to tell it and where the various components should be placed vary from discipline to discipline.

Written texts are the focal point of this book, since they are crucial for most academic work.[9] Fieldwork, oral presentations, seminars, laboratory work, workshops and other types of discussion forums play an indisputable role in academia but it is through the production of texts that we in academia render possible the scrutiny of our studies by our peers. It is through our texts that we disseminate our results to a wider public. It is through texts that findings, discussions and controversies are made available for generations yet to come. Students in most disciplines are therefore trained to write various types of texts.

There is a vast literature that focuses on academic text writing, which is of invaluable help as long as you stay fairly well within the same discipline. The common dogma is often that there is one and only one way to produce credible texts. In contrast, Janet Giltrow elucidates and discusses different academic writing traditions in an eloquent manner. But neither Giltrow, nor anyone else to my knowledge, discusses the opportunities (and challenges) of interdisciplinary contexts. In addition, there are few books that set out to define common criteria of credibility without arrogantly defining it as "research done according to my tradition", thereby dismissing other traditions as "bad" only because the research does not conform with the authors' disciplinary-based interpretation of credible research. With this book, I wish to make it easier to identify common ground as well as differences by facilitating dialogue and collaboration.

It is crucial to understand that among the scholars you meet there will be those who by their own experience have deep insights into the opportunities and challenges of interdisciplinary work without being familiar with

the literature on interdisciplinarity, those who have no personal experience of interdisciplinary work but have gained deep insights through the inter-disciplinary literature and others who will be unfamiliar with anything outside the traditions of their own discipline (Figure 1). You must learn to navigate such a landscape. You must acquire the ability to recognize cred-ibility outside your own area of competence and you must learn how to help others see that your work is credible. You must learn to handle the fact that others will not intuitively understand on what basis your work is credible.
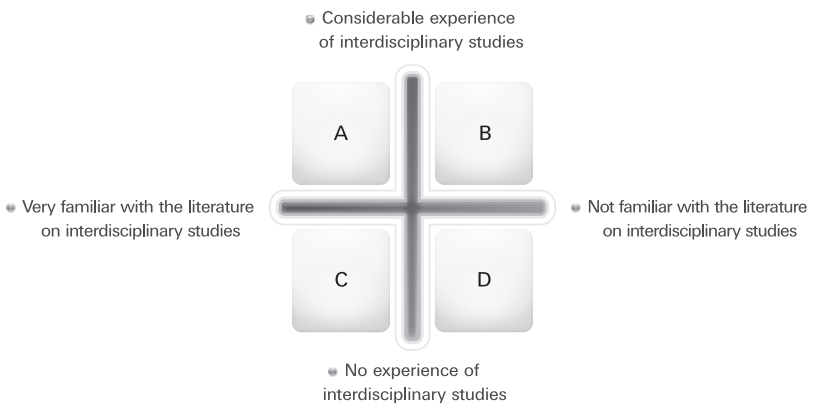
Figure 1 An illustration of the landscape of interdisciplinary competence along the dimensions of own experience and familiarity with literature on interdisciplinarity.

Background

This book draws upon work conducted by the team developing the Environmental Science Program[10] at Linköping University (LiU), Sweden, in combination with ongoing development of a quality assessment framework for graduate studies at the Institute for Resources, Environment and Sustainability (IRES) at the University of British Columbia (UBC), Vancouver, Canada.[11] An early version of the book has been published in Swedish[12] and the third part of the framework has been presented in a paper published in *Higher Education*.

The Environmental Science Program at LiU is an interdisciplinary bachelor and master's programme, which was launched in 1998. The development, chaired by myself, encompassed lengthy discussions among a group of

scholars with differing academic backgrounds on the curriculum to identify key skills and abilities necessary for future environmental professionals.

The basic level courses in the programme integrate elements from the humanities, the social sciences, natural sciences and engineering and make use of both qualitative and quantitative approaches. All those involved in the development of the programme, as well as the majority of the tutors and supervisors, had experience with interdisciplinary work (but no one was at that time familiar with the literature, i.e. we were all firmly placed in square B in Figure 1). The development of the basic courses was both time and energy consuming but they were launched with only minor communication problems among the teachers. In contrast, supervision and examination of bachelor and master's theses surfaced as an intricate problem. Starting in the fall of 2001, all supervisors participated in a number of seminars focusing on evaluation criteria. Concrete examples were used each time to initiate our discussions, often one or two theses in which the examiner and the supervisor did not agree on the quality of the work. I acted as facilitator of the discussions, took notes and revised the notes into a working document that was used as a basis for the evaluation procedure. The third part of the framework presented in Chapter 3, which focuses on academic rigour (Q6–Q10), is a revised version of the framework that has been used in the Environmental Science Program at LiU since the spring of 2002.

IRES, at UBC, Vancouver, Canada is an interdisciplinary research institute that is the home of a major graduate programme with over 100 students. IRES strives to foster sustainable futures through integrated research and learning about the linkages among human and natural worlds, to support decision-making on local to global scales. The unit has 12 core academic staff and about 40 associates in 9 of UBC's 12 Faculties and the research is for the most part conducted in close collaboration with non-academic partners. In October 2006, I became the Director of IRES. Quality assessment soon surfaced as an issue of topical interest among students as well as supervisors and committee members, to a large extent driven by the fact that the latter often represent rather diverse academic cultures. In the development of functional tools for planning, conducting and assessing of master's and doctoral theses at IRES, the academic quality assessment questions (Q6–10) were complemented with two additional sets of questions: how to integrate elements from different disciplines (Q1–3) and how to interact with society outside academia (Q4–5).

A note on terminology

Leafing through the literature shows that the term "interdisciplinary" is used to describe quite different activities.[13] The term "interdisciplinary" is, for example, used to signal work that goes beyond disciplines as well as interaction with the broader society outside academia. Unfortunately, the terminology in this field is convoluted and I therefore describe some key concepts and explain how I use them.

Interaction within academia

The fundamental reason people conduct interdisciplinary studies is that a disciplinary approach fails or is insufficient in creating an understanding of the question in focus.[14] I like the way Donald T. Campbell[15] describes interdisciplinary work and how it differs from monodisciplinary and multidisciplinary work. The figure below is inspired by his ideas.

In monodisciplinary work, scholars specialize in areas within the borders of their disciplines. In multidisciplinary work, scholars also specialize in areas within the borders of their disciplines but communicate and interact actively with scholars from other disciplines. This approach brings about a deepened understanding of contributions made by other disciplines and bringing together various studies provides a multifaceted description of the issue in focus. Multidisciplinarity is usually defined as collaboration among disciplines where each participating discipline remains within its traditional framework, whereas interdisciplinarity usually is used to signify some sort of integration.

Monodisciplinary   Multidisciplinary   Interdisciplinary
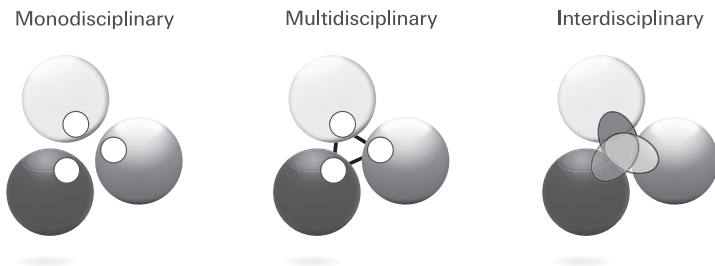
Figure 2 An illustration of the difference between monodisciplinary, multidisciplinary and interdisciplinary work, inspired by the fish-scale model introduced by Donald T. Campbell (2005).

Interaction between academia and the broader society

Sometimes it is argued that interdisciplinary work *must* be conducted in close interaction with stakeholders. This is unfortunate because it creates unnecessary fence-building and confusion. It is clearly possible to conduct advanced interdisciplinary research from a purely academic perspective and there is no reason to exclude such studies when discussing interdisciplinary work. All who strive to use knowledge from more than one discipline face similar challenges. The aim of purely academic research is to create new knowledge. The explicit aim of education and research conducted in close interaction with the broader society outside academia is to produce socially-robust knowledge,[16] which is, at the same time, reliable from a scholarly perspective (Quadrants C and D of Figure 3). The key difference between pure academic research and this latter type of education and research is the extent of interaction with the larger society outside academia.
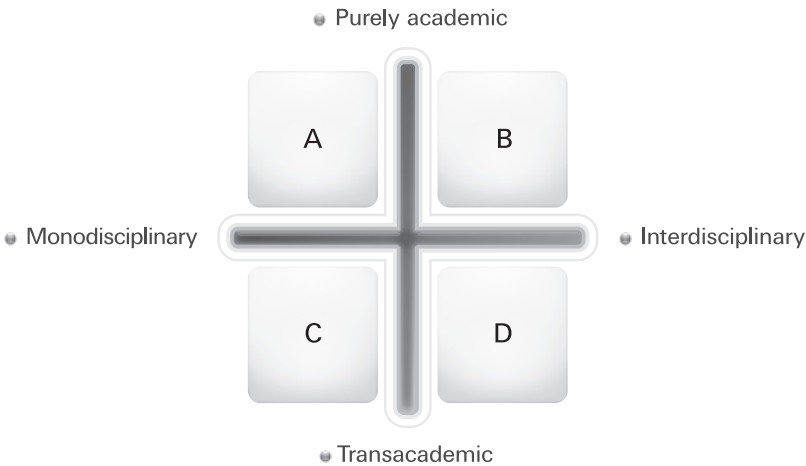
Figure 3 An illustration of the distinction between interdisciplinary and transacademic work. The horizontal axis depicts increasing use and integration of knowledge from more than one academic discipline. The vertical axis depicts the degree of interaction between academia and the broader society.

Interdisciplinary and transacademic work

Research and education, which aim at enhancing our understanding of complex contemporary phenomena, often require the use and integration of knowledge from more than one discipline. Often, it also requires the involvement of extra-academic participants in the research process.

Research in complex areas of topical societal interest often demands the combination of the two. The opportunities (and challenges) in using knowledge from various disciplines are undeniably different from those of close interaction with society outside academia, albeit intertwined.[17] For those conducting interdisciplinary studies, there is reason to separate the two, as such a separation will facilitate the planning, conducting and assessment of such studies.

Education and research conducted in close interaction with the broader society outside academia is sometimes called truly interdisciplinary, issue-driven interdisciplinarity or transdisciplinary. These terms signal that "disciplines" are central to the phenomenon described. This is unfortunate since none of them signals the core focus of this type of activity: the interaction between academia and the larger society. Kinihide Mushakoji introduced the term "transacademic" in 1978. In contrast to the other, more commonly used terms, "transacademic" draws attention to academia, rather than its constituent disciplines, and the term signals activities that both involve and go beyond academic activities. So far, I have been using "interdisciplinary" in its broadest sense, denoting academic activities that go beyond the disciplinary. To facilitate a separation of opportunities (and challenges) related to "using various disciplines" from those related to "interaction with society", I hereafter use "interdisciplinary" to denote the former and "transacademic" to denote the latter. More about interdisciplinary work in Chapter 4 and transacademic work in Chapter 5. The book as a whole focuses on interdisciplinary work, which may or may not be transacademic (quadrants B and D in Figure 3).

Notes

1   I use interdisciplinarity and interdisciplinary work in their broadest senses, denoting academic activities that go beyond the disciplinary. A discussion on terminology follows in the section "A Note on Terminology".
2   More about "reflective doers" in Chapter 4.
3   See, for example, Michael Field *et al.* 1994.
4   See, for example, John Bradbaer 1999; Andrew Barry *et al.* 2008.
5   Peter Bohm 1996; Lisa Lattuca 2001; Angela M. O'Donnell and Sharon J. Donnell 2005; Robert Frodeman *et al.* 2010.
6   For summaries, see, for example, Julie Thompson Klein 1990; Lisa Lattuca 2001; Liora Salter and Alison Hearn 1996; Sharon J. Derry *et al.* 2005; Robert Frodeman and Carl Mitcham 2003; Alan Repko 2008; Robert Frodeman *et al.* 2010.
7   See, for example, Andrew Barry *et al.* 2008 and references therein.
8   For an informed, insightful, easy-to-read and entertaining discussion on different academic styles, see Janet Giltrow, *Academic Writing*, 3rd edn, 2002.

9   My intention is not to comment upon or discuss the production of knowledge from an ontological or epistemological perspective. Instead, I take a practical and pragmatic approach with the aim of enabling education and research efforts across traditional academic borders by elucidating common understandings of credible academic work.

10 http://www.liu.se/tema/miljo/

11 http://www.ires.ubc.ca

12 Gunilla Öberg 2009.

13 For a summary of the discussion on terminology, see Lisa Lattuca 2001. For older literature, see Margaret Barron Luszki 1958; Leo Apostel 1972; Roger B. M Cotterell 1979; Heinz Heckhausen 1972; Erich Jantz 1972; Freremont E. Kast and James E. Rosenzweig 1970; Richard Barth and Rudy Steck 1979.

14 Lisa Lattuca 2001; Veronica Boix Mansilla and Howard Gardner 2003; Christopher Heintz *et al.* 2007; Robert Frodeman *et al.* 2010.

15 Donald T. Campbell 2005.

16 Michael Gibbons *et al.* 1994; Helga Nowotny *et al.* 2001.

17 Sherry R. Arnstein 1969; Arnim Wiek 2007; Roger Pielke Jr 2007; Walter *et al.* 2007.