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## Teaching Portfolio

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### Introduction

I was inspired to become a professor by the professors I saw in the classroom and especially in the field, hammering rocks along an outcrop in the Eastern Sierra Nevada in California, or crouched over an alpine pincushion in the tundra of Alaska. I saw their passion for their subject, their ability to explain concepts clearly and engagingly to satisfy curiosity and to answer pressing questions about global environmental change and human's role on Planet Earth. It was only later that I realized my teachers were also researchers, helping to create new knowledge as well as pass along what is already known, and saw how these two roles could re-enforce each other. My professors placed existing knowledge in a coherent framework that shapes how I see the world to this day, as well as delineated the boundaries of knowledge and pointing out areas ripe for new research, inspiring me to help contribute to filling these frontiers. Over time, professors became mentors, helping to shape my career and open doors that eventually led to me joining Lund University as a lecturer in 2010, and a senior lecturer since 2014.

Clearly, I have some big shoes to fill in following in the footsteps of the professors who inspired me to teach. I appreciate this opportunity in creating this teaching portfolio to reflect on what I myself have learned so far as a teacher, how my views of student learning have evolved, and where I want to further develop my teaching. Overall, reflecting on these topics, I can see three over-arching themes in my teaching philosophy:

1. A focus on the fundamental skills of making and supporting academic arguments,
2. Linking the scholarship of research and teaching, and
3. Developing teaching materials for students to take charge of, monitor, and reflect on their own learning.

These themes stand out for me because I can see both my own development as a learner and a teacher, and my evolving view of student learning through these lenses. First, writing is at the heart of scholarly endeavor, but I did not give much thought to the craft of writing while I was caught up in writing my dissertation. Through my experience in reading and commenting on countless student texts, as well as a journal editor and reviewer, I began to see repeated patterns, and from these realize the underlying structure of making an argument, a skill that was deeply developed through my collaboration with my colleague Ladaea Rylander from the Lund University Academic Support Centre in developing a peer writing tutor program, which we describe in a book chapter coauthored with one of the tutors (Nicholas, Rylander, and Brady, in press; Appendix 1). Here we trained tutors to help their peers make and support claims, using strong reasoning and evidence, thereby strengthening their own writing skills.

The second theme has emerged as I aim to take an equally scholarly approach to my teaching and research programs, treating each course as an experiment to be refined based on analysis of

previous experience and evidence-based best practices, as well as an opportunity to share research findings and be inspired in my research directions by the fresh ideas of the students. I have particularly focused on teaching the process of research throughout my courses, and in supervising 23 master's students to completion of their theses. Making this closer connection between the classroom, the field, and active scholarly conversations is important to me.

The third theme flows from this connection between research and teaching; influenced by pedagogical research I have encountered through participation in Lund University pedagogical courses, I have become convinced how important self-assessment and reflection are to student learning, and therefore sought ways to make their learning visible to students and develop tools for them to assess themselves, not just expect one right answer drawn from a pre-determined list. In this document, I present my reflections on my philosophy and strategies as a teacher, using the Pedagogical Academy assessment criteria as an organizational frame to trace the development of my approach and plan my goals for the future.

### **Background: Teaching, Advising, and Educational Leadership Experience**

My views on teaching have developed through my experience as a course responsible in the Lund University International Master's Programme for Environmental Studies and Sustainability Science (LUMES), where I have designed and taught three courses: (1) a foundational natural science course that kicks off the program (initially called Environmental Problem Awareness, now redesigned thanks to the LATHE course as Earth Systems Science, which I am now teaching for my 5<sup>th</sup> year); (2) an elective course, Rural Systems and Sustainability, which I taught for four years before the LUMES curriculum redesign; and (2) a two-week module, Quantitative Methods for Sustainability, which I taught for three years and which is now incorporated into my Earth Systems Science course. I have been honored for two consecutive years to be chosen by the LUMES students as a Commencement Speaker at graduation, which I believe reflects positively on their assessment of my commitment to teaching.

In addition to the courses I have developed and led myself, I have co-developed and taught a summer course on Global Climate and Environmental Change at Kyung Hee University in South Korea, as well as given guest lectures in the Lund University Master of Science in International Development and Management (LUMID), seminars in the Climate, Biodiversity, and Ecosystem Services in a Changing World (ClimBEco) PhD program, and invited workshops for the Faculty of Social Sciences and the Lund University Social Innovation Centre on poster presentations and research design.

Since joining LUMES, I have supervised [23 MSc students](#) in successfully completing their theses, in topics ranging from environmental education in Iceland to winegrowers' adaptation to climate change in Australia, as well as supervised one master's student from Uppsala University, which was an excellent opportunity to reflect on higher education at the national level. I have mentored six of these students to publish their theses in international peer-reviewed journals (underlined names on publication list in CV), with three more close to submission, and six [presented to the public as blog posts](#). I have supervised one PhD student to completion, and am currently

supervising two more, as well as two newly hired postdocs joining my group this fall. I have also served on the PhD examining committee for one student at Stockholm University, and will do so for another student in November 2016 (please see CV).

I am increasingly pursuing leadership roles in education, starting with my participation in the core group of faculty who redesigned the LUMES curriculum in 2013, and having joined the Advisory Board of the PhD school ClimBEC (Climate, Biodiversity, and Ecosystems in a Changing Environment) in 2015 and the Board of Directors of the Centre for Environmental and Climate Research (CEC) in the Natural Sciences Faculty, where we oversee graduate education. These opportunities have given me a chance to reflect on education at a higher level and its integration across faculties at Lund University and more broadly on the role of the university in society.

## 1 An approach that promotes the students' learning process

A central skill I am to help my students develop is **ability to make compelling arguments**, that is, to make a claim and support it with logical reasoning and robust evidence. Making well-supported arguments is the essence of academic scholarship, and essential to meaningfully engage with, and contribute to, civic discussion and debates. For me, the purpose of helping students to develop their critical thinking is two-fold. First, it produces more rigorous scholars who are driven by curiosity. Second, it helps channel my students' desire to make the world a better place into more productive and focused efforts.

I have honed this focus through a collaboration with Ladaea Rylander, a writing specialist at the Lund University Academic Support Centre. Together, we have developed a flagship peer writing tutor program, now in its third year, which is the subject of a book chapter we have co-authored (Nicholas et al., in press) and is now being expanded to other departments. Ladaea provides a one-day training to a group of tutors selected from the upper class, who then read incoming student's essays and provide several rounds of feedback using forms I developed and facilitate two in-person writing sessions where students get feedback from the tutors and their peers. Teaching the **craft of writing** has proven to be a powerful way to improve students' critical thinking and communication skills, as seen in the strong improvement in this student's central claim below:

First Draft: Intention	Final Draft: Claim
"In this essay I will <b>discuss</b> how vulnerable Sweden is to the decline in the number and diversity of wild bumblebees, with also including a comparison with the rest of the EU."	"This essay intends to <b>argue</b> that bumblebees and their pollination services are not of a great economical importance to Sweden."
<p><b>Student:</b></p> <p>From my previous studies we were taught not to take a stance, we were only allowed to discuss and analyze, but always being objective. I therefore find it very hard to present a standpoint on a [specific] topic."</p>	<p><b>Tutor:</b></p> <p>"Now to make what we are writing significant and so that ultimately we can produce a thesis that contributes to scientific knowledge, rather than <u>summarises</u> it, we have been asked to write with an opinion."</p>

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From the peer writing tutor program overall, we have found benefits both for students and peer tutors. Students have benefitted from motivation from their tutors to understand why and how to make claims in academic writing, and were empowered to make bolder claims that they were more excited to write and are more exciting to read. The tutors have benefited from both improving their own writing, and honing their teaching skills (Nicholas et al., in press). Overall, it has been tremendously satisfying to see the improvement in student writing, and to hear students ask each other “What’s your evidence?” as they discuss ideas in class and beyond.

I am obsessed with measuring and monitoring student learning, using the principles of constructive alignment (e.g., Biggs and Tang, 2011) to identify a handful of core skills and concepts I want my students to master, then working backwards to ensure that every course activity and assessment supports their learning in these domains. To make this clear to the students, I present my course on the first day of class in terms of the learning outcomes it is designed to achieve and the activities that are designed to teach and assess these outcomes. Using this approach as a guiding philosophy has been extremely helpful in designing activities that directly support the skills I want the students to master (e.g., working in pairs to design and carry out an ecological field experiment, analyze the data using the R programming language taught in class, and write up the work in scientific paper format).

I have studied the framework for higher education in Sweden through my completion of the Docent course at LTH. For this course, I became familiar with the learning outcomes to achieve graduate degrees in Sweden. In this course, I led a research survey of over 100 PhD students and their supervisors to study how PhD students and their supervisors viewed student competencies in eighteen national learning outcomes. We found that supervisors rated PhD students more highly than they rate themselves, that men rated themselves more highly than women, and that the strongest skills overall were specialized methods and knowledge, while teaching, outreach to society, and professional ethics were rated lowest (Nicholas et al., 2013). I have used these in advising my PhD students and we have assessed degree progress relative to those goals, in one case spelling them out explicitly. This conveys the expectations for a PhD clearly and gives students the chance to be self-reflexive learners.

Diversity is a hallmark of the LUMES program. It is a primary motivation for why students choose to study at LUMES, and a core value of teaching in the LUMES program. For example, for the cohort of 47 students that started fall 2015, students are 90% international, representing 20 countries. The vast majority are studying in English for the first time. They range in disciplinary training from sociologists and anthropologists to engineers and a PhD in physics pursuing a career change. I strive to be aware of equality issues in the classroom, for example, in creating opportunities for more introverted students to contribute to discussion by submitting written comments or first discussing in pairs, rather than only calling on the more extroverted students who often raise their hands.

Working with diversity is an opportunity to demonstrate fair practices that promote equality, which I aim to follow in my own practices as a teacher. For example, I grade blind in order to avoid the “halo effect” where good students are given the benefit of the doubt, assessing across

questions (grading all examples of question 1 together, then question 2, across exams) rather than across students (reading through an exam from start to finish) to maximize independence, reshuffling the order of exams graded between questions to prevent systematic order effects, and asking a colleague to comment on the exam wording before administering it to avoid ambiguity (Biggs and Tang, 2011, p. 232).

To create continuity for students, I have worked with my colleagues to better coordinate between courses to ensure progressive development. For example, I have selected a current news article with my two colleagues who teach the other courses in the first semester. We each cover different aspects of this article in our courses and have the students reflect on the material from a natural sciences, social science, and integrated sustainability science perspective, mirroring the increasing sophistication of their thinking we aim to develop in the program.

I have also used constructive alignment at a higher level to help redesign the entire two-year curriculum in our department with a small team of colleagues. We have followed the five core competencies in sustainability science promoted by Wiek et al. (2011, *Sustainability Science*) to redesign a more active, coherent, and integrated curriculum.

I watched students struggle with writing, often impressed by their verbal articulation and the contrast between what they were able to convey on paper. Reading many student papers, as well as serving as a journal editor for *Climatic Change*, gave me insight into the patterns and structures of effective writing, which I have worked to make clear for students. This led me to develop tools to teach the principles behind clear writing, including a rubric for writing scientific papers that I use to both teach and assess writing (included in Appendix 1, peer writing tutor materials). This makes both the structure and purpose of writing clearer to students, allowing them to **better assess themselves and their peers** and to know what they need to do to improve. As part of my commitment to disseminate best practices, I circulated this rubric for feedback from colleagues at universities in Sweden, Canada, the UK, and the US for pilot testing before I made it publicly accessible on my website. Demystifying the grading process and giving students the criteria to assess themselves empowers them to take charge of their own learning.

Feedback is essential for learning. One of the most effective characteristics promoting student learning in a large meta-analysis, which was more than twice as effective as the average, was when students provided formative evaluation to lecturers; that is, they gave feedback on the course and their learning, and are able to offer suggestions for improvement that can be incorporated in the course while it is running (Hattie, 2009). I have seen this in my own experience as a student, where I still clearly recall a young female professor I had in 2002, who gave us the chance to submit several anonymous rounds of feedback during the course on what was going well and what could be better. I was impressed that she shared the results in class the next day, and made changes as a result.

I have followed this practice in my own teaching, where I use formative feedback during the course to improve the course while it is offered. I can see that students appreciate a chance to be heard and share ideas. They appreciate seeing their comments taken seriously and also to see their views in a larger context, recognizing that others may agree or disagree with them (for

example, usually I receive, and share, conflicting comments like “the course literature is too basic” and “the course literature is too difficult.” As a result of formative feedback, I have changed things ranging from how I call on students to how much time is allocated to discussion, changes that promote student learning.

Summative feedback takes place at the end of the course through both formal course evaluations, and an informal lunch seminar open to all students to discuss the course and offer suggestions for improvement. The full original evaluations for the courses for which I have been Course Responsible are included in Appendix 2, as well as summaries for the last 3 years (since my department initiated this practice). The teaching scores reflect the varied assessment methods I have used, including self-designed research projects and in-class examinations that were then both peer- and self-assessed to promote learning (in addition to assessment by the teacher for the final grade).

## **2 A basis in research and a scholarly approach that reflects subject breadth and depth**

Teaching and research are linked in my classes in several ways, to show the current boundaries of the field as well as how these boundaries are drawn, contested, and evolving. First, I incorporate current research from my departmental colleagues and my own work in my teaching, which helps to demystify the process of research and to connect students with current research. Second, I actively create and promote opportunities for students to get involved in faculty research, including organizing the first Research Symposium between researchers and students in my department. Third, I draw course materials and activities from recent scientific articles, to link student learning with the current state of the field. In my courses, we spend time analyzing how papers are structured and how evidence is used to support arguments, to make the interrelated processes of research and writing more transparent.

One example of my teaching scholarship is a comprehensive climate change curriculum I developed based on the latest synthesis research findings from the Intergovernmental Panel on Climate Change (IPCC), in collaboration with a team of five LUMES students. This idea came from attending a presentation of the new release of the Fifth Annual Assessment report, which represents the state of the art of climate science, impacts, and policy, but stretches over several thousand highly technical pages. We took the Summary for Policymakers as a starting point and used qualitative content analysis to determine which subjects the summary included, reasoning that that should be the basis for understanding climate change. I combined this with previous psychological research showing five elements necessary for understanding and supporting action on climate change: “It’s warming, it’s us, we’re sure, it’s bad, and we can fix it”. We then surveyed over 70 courses on climate change around the world, finding that the majority (56%) focused on only one of those topics (Nicholas et al., 2015, poster presented at the American Geophysical Union with five MSc student coauthors- Appendix 3). Our framework is designed to be used by teachers to decide what material to include and encourage a comprehensive approach to teaching climate change. We have presented this framework at international conferences in the US, France, and Belarus, with enthusiastic response by teachers who are adopting it internationally.

Another example of linking teaching and research is my redesign of my Earth Systems Science class using the nine Planetary Boundaries (Rockström et al., 2009; Steffen et al., 2015), which introduces students to the natural science foundation for sustainability challenges in a context now widely used and debated in development and policy circles. The idea to seek a base in current research literature to frame the class came at a student suggestion, who asked me how to cite the former course structure in his term paper. This made me realize the former themes had been rather arbitrarily chosen, and I wanted a more solid research grounding. The planetary boundaries organizing framework has proven very helpful to student learning, as it helps them track overall progress in the class and relate concepts to each other, as well as grasp the concept of operationalizing variables into researchable indicators. I have also seen them incorporate it into their social activities, including a potluck menu and a quiz night, showing that they have fully integrated it as part of their LUMES experience!

My teaching is particularly shaped by my topic of global sustainability and my students, who are often passionate advocates with experience in education, non-governmental organizations, and the like. They are inspired to make the world a better place, and want to gain the tools and facts to do so. Yet often they feel constrained by what they perceive as the cold, heartless world of academia, and the belief that facts speak for themselves. I seek to change their worldview: to promote objective gathering and analysis of data and clear presentation of the information those data contain. But still, science is informed by values, from the kinds of questions scientists form to how and to whom we communicate our results in society. I try to create opportunities for students to identify and voice these values that motivate their study and shape their worldview. The past 30 years of climate science history have clearly shown that facts are necessary but not sufficient to change societies, hearts and minds; this requires an exploration of values and an intelligent public debate about those values, for it is values that shape and underlie policies and incentives, as well as the more subtle norms motivating our everyday behavior.

One of my favorite parts of being a professor is **mentoring students**. My philosophy of student supervision is to provide a graduated level of intellectual independence, while retaining focused input into research design, analysis, and writing as appropriate. I aim to demonstrate the very real element of discovery in the research process, to help students move away from a mindset of trying to get the one “right” answer, as if on a multiple choice test, and towards a mindset of figuring out the criteria by which they can weigh competing options or hypotheses for themselves. My goal is to balance the opportunity for students to learn from their own choices, while helping them avoid common pitfalls and steering them in directions that will contribute to the field. I encourage my students to write early and often, and to revise constantly, so that they see the ways in which writing solidifies and develops their thinking. I train my students to focus on telling a story visually, starting with making conceptual figures at the beginning of a paper and adding more empirical results over time, to encourage them to see the big picture of their research contribution as well as be able to explain its key findings to a wide audience. I also focus on professional skill development, including giving lunchtime seminars on academic writing, publishing, and time management, and on the ethics of research design (human subjects) and practice (coauthorship norms).

In terms of supervision, I have graduated 23 MSc students and one PhD student, with two PhD students under current supervision. I have devoted extensive time and effort to mentor students to design, carry out, and write up publishable original research. I am proud to say that I have coauthored the first paper in my department resulting from a master's thesis, introducing the concept and analyzing the benefits of urban food forestry (Clark and Nicholas, 2013, *Landscape Ecology*), a trend I have continued with five more MSc students (see underlined papers on CV) on topics as diverse as local food in Iceland (Halldórsdóttir and Nicholas, in press) to cultural values of vineyard landscapes (Winkler and Nicholas 2016). I currently am working with three more MSc students on final revisions to submit papers based on their thesis research with me. These joint publications are an important part of students' development.

Importantly, my MSc supervision has included a strong focus on educational topics, including a thesis on environmental education in Icelandic primary schools (Hallfreðsdóttir 2011), as well as youth engagement in informal education in the United Nations climate negotiation process (Darrach 2011) and the Global Landscapes Forum (Nasir 2016), all available on my website. Further, an assessment of the climate change curricula in Canada compared with research-based recommendations for maximum impact coauthored with a master's student is now in review at *PNAS* (Wynes & Nicholas).

I am also an involved PhD supervisor; I am committed to accompanying my PhD students for at least one field campaign. For my first PhD student, who graduated in October 2013, this included spending a week doing fieldwork in Ecuador, administering household surveys to look at benefit distributions from a payment for ecosystem services program in the Amazon (Krause, Collen, and Nicholas, 2013), as well as led to mentoring a master's student I met in the field, eventually resulting in a second publication (Collen et al. 2016). I enjoy being inspired by students to question my fundamental assumptions and investigate new topics.

### **3 Teaching skills and commitment**

Creating a positive learning environment where students feel valued, engaged, and respected is a key aspect of my teaching philosophy. Such an environment is not only a more fun and rewarding one to work in, but also promotes student learning through enhanced peer collaboration. Since I teach the first course in the LUMES program, I have the opportunity to create this environment from the first day of the program, where we blend social activities (name games, icebreakers) with communication about program and course goals and function. I make it a point to learn all of my student's names by the first week of class, and ensure that they know each other's as well, to create a collaborative environment. (This is facilitated by creating a photo list of all new students in the first week, which we share with all staff and students.)

In the second week of the course, I lead a 3-day, 2-night field trip. Here my colleague Ann Åkerman leads a bus excursion that introduces students to the natural and cultural geography of Skåne, and I lead field experiments where students collect, analyze, and present observations on water, biodiversity, and land use change. This retreat also includes cultural trainings (for example, the card game Branga, where students simulate the frustrations of coming to a new environment where expectations are different by playing a card game where they all have been



given different rules, but cannot speak to communicate this.) I have also included trainings on personality types (e.g., introvert/extrovert) and tips for effectively including everyone in a group, including having students write groupwork contracts to clarify expectations for group projects and collaborations at the start. This compliments one of the core intended learning outcomes of the LUMES program, the “interpersonal competences” including leadership, communication, and self-reflection (Wiek et al., 2011), which are critical for successful work in sustainability.

#### **4 Holistic view and interaction**

Already from the beginning of my Earth Systems Science course, I work to paint a clear picture of how this course fits into the overall LUMES program and how the skills they develop there will be further developed throughout the program. For example, I have a strong focus on academic arguments and writing skills. We read and discuss the book “They Say, I Say,” (Graff & Birkenstein, 2010), which positions academic writing as joining in an existing scholarly conversation and augmenting it with your own arguments, supported by evidence. We discuss how this skill is fundamental to scholarship across disciplines and will be developed throughout the program, culminating in the master’s thesis. We read and discuss former master’s student’s theses, and talk about their development.

Our students are highly motivated by environmental issues. Many of them have extensive professional experience, and they have a variety of reasons to pursue a master’s degree, ranging from a desire for specific skills training, passion to investigate a certain topic more deeply, or a desired career shift. It is important to me to understand my student’s learning goals and help them see how the LUMES program can help them achieve them (as well as being realistic about what the program is not suited to achieve). I encourage students to pursue professional development opportunities (for example, linking their studies with internships or research assistantships), and invite guest lectures both within my courses and outside of course time to provide views on career paths and current research. These visiting guests have included academic colleagues from the US working on ecosystem services and conservation finance, non-governmental organizations (a climate educator who has bicycled across five continents) as well as corporate views (a clean cookstove entrepreneur, and the head of sustainability for IKEA Sweden). This gives students a chance to interact with civil society and test their classroom views in an applied context.

#### **5 Continual improvement and in-depth reflection on the basis of knowledge of teaching and learning**

Similar to the reflective texts my students write to monitor their own learning, I also write about my teaching experiences to better learn from them. Since 2014, I have kept a website where I share teaching resources I have developed, such as rubrics, the peer writing tutor materials, and the We Can Fix It World Café. I also maintain a blog where I share my thoughts for students, ranging from research design to applying to PhD programs, as well as reflect on my own experiences (selected posts included in Appendix 4; all available from <http://www.kimnicholas.com/blog>).

Blog posts have included my reactions to articles I read in education journals and the popular press (for example, [this post](#) on “Why I posted last year’s final exam on the first day of class”), insights from conversations with colleagues (e.g., [simple tips on research proposal writing](#) from a conversation with Harriet Bulkeley), my own philosophy and teaching perspective as exemplified by materials I’ve created (a widely cited post on [“Cheat sheets for writing scientific papers”](#) where I share rubrics, a paper outline, a guide to common problems I see in student writing, a template for a master’s thesis proposal, and slides presented on research design), a [guide to new teaching tools](#) such as the LU Play video recording app and realtime survey tools for classroom use that I learned about at a Lund University USV teaching retreat), and a response to an article on [how to follow open data principles](#) (Wolkovich et al., 2012) that I’ve implemented with my lab group. I share these posts via Twitter and Facebook with my colleagues and students, as well as other instructors around the world, and have received positive feedback from students as well as other instructors who are using my materials in teaching.

I have eagerly pursued professional development opportunities within teaching throughout my career. I came to Lund with extensive pedagogical training from the US during graduate school, including a one-year teaching fellowship at the University of Wisconsin funded by the National Science Foundation to teach the theory of inquiry-based learning and pair graduate students with elementary school teachers to design and carry out age-appropriate science learning activities. I also participated in a graduate-level course on Science Course Design at Stanford University. Since coming to Lund, I have taken advantage of all the pedagogical opportunities available to me instructed in English, including completing both levels of the Learning and Teaching in Higher Education (LATHE) course, as well as the docent course at LTH. This training has given me a deep appreciation for focusing on student learning as the core of my teaching, and opportunities for my own learning in aiming to continuously improve my teaching.

## **6 Educational Leadership, Development, and Dialogue**

I have made significant contributions to international peer-reviewed literature in education. First, an article I wrote to describe the peer-review process for early-career researchers getting started on contributing journal reviews (Nicholas and Gordon, 2011; Appendix 5) has been used by teachers at several universities in graduate seminars, as well as adopted by several journals in their instructions to reviewers, and I use it in my own teaching. I have also mentored a master’s student to develop his thesis analyzing sustainability science curricula across 54 international bachelors and masters programs into a widely cited publication (O’Byrne, Dripps, and Nicholas, 2014; Appendix 6), which recently resulted in an invitation to visit Jönköping International Business School to “advance their knowledge on sustainability” to inform a new sustainability education and research network.

In terms of leading the development of different forms of teaching and examination, I have developed an innovative form of self-created, peer- and self-graded final exam, which has proved very effective for student learning, and is being considered for adoption by colleagues at Stockholm University. This was inspired by a meta-analysis of over 800 meta-analyses, involving over 50,000 studies and 250 million students, showing the characteristic that produced the most positive outcomes on student learning (nearly 50% larger effect than the next best characteristic, and more than three times as effective as the average strategy tested) was when students self-

report grades (Hattie, 2009). It appears that this feature gets students to become more reflective and therefore deeper learners, in effect teaching them how to learn by encouraging them to better monitor, evaluate, and assess themselves, looking for evidence of how they are doing, keeping an eye out for errors and looking for ways to work more effectively (Biggs and Tang, 2011).

In brief, I have applied this finding to develop the final exam for my Earth Systems Science class as follows. At the start of each class, I hand out index cards and ask students to write a potential exam question based on the day's activities. I read them that night and comment on them at the start of the next class, helping students identify the most important aspects of the material. I take these questions and modify them into a final exam, which focuses on demonstrating the intended learning outcomes of content knowledge about the biophysical function of Earth systems, as well as skills in critical quantitative and written analysis. Students take the exam in class and turn it in, then are put in teams around each question who develop grading rubrics that they use to anonymously assess their peers. The full rubric is compiled and they use it to grade their own exam, with the option to submit corrections demonstrating their full understanding for half credit. The final grade given is the student's own, unless their self-reported grade against the rubric is more than 10% off from that given by their peers (a rare occurrence, usually about 5% of students). Students have found the exam demanding but rewarding; developing and applying the grading criteria themselves makes them better understand how to find and support a strong answer.

Connecting to the world at large is an important part of my teaching, both in linking my activities in the classroom to society, and in bringing students in contact with society to inspire the design of their research to address pressing problems, and to share their results. For example, I brought my MSc student Seth Wynes into an open social media forum (Reddit "Ask Me Anything") on climate solutions where I was a member of a panel with meteorologist, NASA scientists, and well-known journalists. One of his remarks received among the highest ratings from the audience. Further, I have mentored students into writing blog posts summarizing their research for a public audience, on topics ranging from seagrass conservation to organic winegrowing (Appendix 7), highlighting the importance of public communication. This is in line with my own efforts at science outreach and communication, ranging from an active Twitter presence (@KA\_Nicholas) to interviews with public magazines to writing popular science myself, including a feature article and an Op-Ed for *Scientific American*.

One of my most effective teaching activities came from a student complaint about his dissatisfaction of focusing too much on the problems of climate change in the first year I taught the Environmental Problem Awareness course. I agreed that a focus on solutions was more empowering, and designed the We Can Fix It World Café teaching activity in response. In this World Café, students read about innovative climate solutions from the personal to global levels, which they analyze in depth and debate with each other. This has been an inspiring note on which to end our course, and is written up as a teaching activity on my website (Appendix 8).

## 7 Conclusion

Looking ahead, I have several goals for further developing my teaching. First, reflecting on the past five years of teaching the same course, although I have made sweeping and continuous changes to the course, I can feel that I am no longer being challenged by teaching this course, which has become familiar. I would like to develop my teaching in a new direction, more closely connected to my research on food systems, land use, and climate in a smaller seminar format. I would also like to get new ideas and perspectives on my teaching through taking advantage of teaching exchanges offered through STINT for Lund University faculty, as well as the ERASMUS+ teaching mobility program. Further, I would like to deepen connections with my LUCSUS colleagues by sitting in on each other's courses, finding ways to increase overall program coherence, and take advantage of peer teaching evaluations.

Second, I would like to further increase the accessibility of my teaching via online platforms. I strongly believe in open research principles, and would like to apply these to teaching so that teaching materials are freely available and encourage collaboration. I can expand my participation in social media and my own blog as well as develop video lectures that can be used both in a flipped classroom model, as well as made accessible to learners all over the world. Finally, I would like to further develop my professional Swedish language skills to access more outreach opportunities. I look forward to pursuing these opportunities to continue to develop my teaching practice, as part of my own lifelong learning as well as for the benefit of my students.

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