# Statement of teaching philosophy and experience

## Introduction

The purpose of this teaching portfolio is to give an overview of my background, thoughts, and practices as an educator at university. I will through the fundamental principles of my teaching outlined below discuss how I practice my teaching and the literature I draw inspiration from for my choices as an educator. I will further outline my views of which directions I wish to develop myself as an educator and how to accomplish this in corporation with my teaching colleagues and students. As a university educator I see it as my finest duty to help prepare the minds of our students for the societal challenges of tomorrow. This is not always done by doing what we have been doing for centuries and decades, but by being open to educational research and challenge our own ideas and practices. As an educator one of the most important questions to raise is why do we teach the way we do? The guiding principle for my teaching was formulated more than two thousand years ago in ancient Greece:

*"for the things which we have to learn before we can do, we learn by doing" (Aristotle 349 BC).*

## Fundamental principles of my teaching:

1) Active learning among students fosters development of critical thinking and analysis skills.
2) Students and educators are partners in working towards shared educational goals
3) As an educator and researcher, I want to introduce students to the world of research
4) As an educator I encourage students to become thinkers and think outside the box

## Active learning

As an educator I see the students as active and their learning to be a result of something that takes place in their own minds. To facilitate that the students obtain a deep learning approach a key factor that I ensure in my teachings is Constructive Alignment with the Intended Learning Outcomes (Biggs and Tang, 2007).

An illustration of use of constructive alignment in my teaching is the use of small-scale experiments in my lectures to illustrate physical processes. I have in 2020 been teaching as co-course responsible the course "GEOF105 Atmosfære og havfysikk" at University of Bergen, which is an undergraduate 10 ECTS course with about 45 students attending. In this course I introduced small-scale experiments to facilitate deep learning among the students aligned with the specific learning outcome "Understand fundamental principles within atmospheric thermodynamic, radiation, microphysics, and dynamics". An example of such experiments was when I with the help of a plastic bottle, a bit of water, and smoke from a burned matchstick illustrated how heteorogeneous nucleation caused formation of visible cloud droplets. This experiment was also done without the smoke to illustrate the case of homogenerous nucleation, which did not cause any droplets to become large enough to pass the *critical radius*. Before, during, and after the execution of the experiments I engaged the students with questions designed to make them reflect upon the theoretical material covered on the "black board" and their observations of the experiment. My intention was to imitate the Socrates teaching model in the classroom knowing that debates and conversations, which questions students' ideas lead to students, who are less likely to be adopting a surface approach to learning (Trigwell et al., 1999). While the students responded very positively as illustrated by the evaluation of the perceived usefulness of the experiments (Figure 1 in Appendix 1 "On using experiments as an integrative part of lectures to illustrate processes and improve understanding"), the question exists as to how to quantitatively determine the educational outcome of these class-room experiments. I have specifically addressed this question in an iEarth conversation on teaching (Appendix 1), which deals with whether these types of experiments are learning tools or entertainment (Crouch et al. 2004). In the coming semester I will therefore integrate quizzes before and after the experiments in an attempt to measure directly the learning gain from the class room experiments. I expect with the quizzes to be able to obtain a numerical metric for the understanding

related to the learning outcome of all students in the class and not only those who are active participants in the verbal discussions (Brame and Biel 2015). However, introducing quizzes is only one illustration of my attempt to make the students become active learners while at the same time measure the learning outcome. Discussions in the class room will still be an integrative part of the class-room experiments. However, while I actively urge students to ask questions and participate in the class discussion a vast majority of students remain silent even when I wait for answers or questions. Such situations of student inactivity have been documented and studied previously by among many others Fritschner (2000) and Karp and Yoels (1976). They found that in typical introduction classes less than 10% of the students were accountable for three quarters of the verbal participation. While variations in student activity are found between class rooms and between educational cultures these reported numbers are aligned with my own class room observations. Fritschner (2000) reported that students in general acknowledge verbal participation as essential to the learning process in the class room and considered it a part of the lectures. The question therefore exists as to why a discrepancy exists between the actual in-class participation and the acknowledgement of the role of participation in the learning process. This question will be another key focus in the development of my teaching as an educator.

Several factors influence verbal participation, but students have reported confidence as their main motivating factor for participation (Rocca, 2009). It is therefore a key focus of my teaching to create an environment in my class room where my teaching portraits respect and care for the students, and students respect one another. To promote a feeling of empathy and personal relatedness towards the students I ensure that I know each individual student by name irrespectively of having ten or fifty students in my class and ask questions towards their study background and from which country or part of a country they originate from. In addition, some students consider the instructor as the expert who impart the "truth" to the students (e.g. Fritschner, 2000). Naturally, it is my role as an educator to ensure that such perception at the individual student level does not inhibit class participation. To challenge the perception of me as "the expert" I often address the students in the verbal form "Lets try to figure out this together, what if…" when either lecturing on a difficult topic or addressing a problem of understanding raised by a student. In the future, I plan to continue emphasizing the class room as a safe, comfortable environment and develop together with the students the path for achieving this goal.

While facilitating participation in verbal discussions among all students is one of my overarching goals, it has long been documented across fields that peer discussions as collaborative learning can improve students' academic performance (Petonito, 1991). I have therefore in the past integrated short periods (often 2-3 minutes) of student-student discussions in response to more multifaceted questions raised during the lectures. In relation to my planned expansion of in-class room experiments I will integrate the quizzes after the experiments with peer-discussions. This choice is based on my aim to create a shared understanding among the students of how the theory and the observations of the experimental outcome fitted together. In my in-class teaching when integrating student-student discussions I often prefer to keep the groups at a size of 2-3 members and often for practical reasons based on who the students are sitting next to. By keeping the groups relatively small I minimize the risk of students acting as "free riders" and automatically encourage everybody to reflect upon the material covered.

In the past I have had experiences from facilitating an active learning environment when I developed and taught the course "*Master Class – Isotopes in the Atmospheric Hydrological Cycle"* at a Chinese Academy of Sciences Institute (Appendix 2). The course consisted of 30 students at master and PhD level and lasted 40 in-class hours. As the intended learning outcomes of the class had components, which targeted different levels of Bloom's revised taxonomy (Table 1 in Appendix 2), it was natural to encourage student-student and student-teacher interactions to facilitate deep learning. However, teaching in an environment with varying levels of English proficiency and past exposure to teaching methods build on classroom discussions I decided to establish the physical class room with "study islands" (Figure 1, Appendix 2). Changing the layout of the classroom was in line with the finding of Brooks (2011), who concluded that enhance learning spaces on their own can improve student learning beyond student's abilities. In addition, by restructuring the class room, it also offered the advantage that I would be able to easily move around the classroom encouraging discussions within the groups, and the advantage that the students could more easily help each other and work together during the

assignments (Figure 1, right panel). Particularly the last point was important as it aided differential teaching among the 30 students, who were not from the same academic background. Using student-student interactions in larger groups as a mean to facilitate active learning does however raise the question of student composition and how to make the most optimal choices when organizing the groups as instructor. As an instructor, one has to make the choice of whether to let the students organize themselves or to actively configure the groups and whether to keep the groups constant or change throughout the course.

## Students and Educators as partners

Being aware of the relation between the deep learning approach of students and their perceptions of the quality of teaching (Ramsden, 1992) it is important that the students from the beginning accept the teaching methods applied in class by the instructor. My teaching is therefore structured around giving the students from the beginning a clear awareness of the shared goals of the course through a discussion of the intended learning outcomes. By having a collaborative process in which students contribute to the shaping of the learning of the course, research has documented increased student engagement, confidence, and importantly ownership of the learning (Mercer-Mapstone, 2017). Specifically, the student moves from being a customer at the university to become a member of the university community with increased sense of belongingness.

Through my mobility during my Master degree, PhD degree, and Postdoctoral fellowship I have had the pleasure of experiencing higher levels of education practices in the USA (University of Washington, Seattle; University of California, Berkley; and University of Colorado, Boulder). While I can only speak for my experiences at these three top-tier universities my understanding of high-quality teaching has been shaped significantly by my stays at these universities. Here I experienced the valuable lessons on the possibilities of developing new courses targeting specific topics. Through the development of the course the students were offered the opportunity of contributing with ideas to the curriculum. Naturally, this fostered student-student exchanges and enhanced relationships as developing the curriculum became a negotiation among the students. Furthermore, building upon many students' background, the curriculum also became more diverse.

Through my time at universities in the US I also saw the positive outcomes from minimizing the distance between the students and the instructors. Through the organization by university staff of extracurricular courses and activities and the consistent use of "Office Hours" the students interacted with the instructors on many different levels. I believe that this creates more optimal learning environment compared to meeting just the couple of hours per week during the semester when the instructors were lecturing. I therefore seek to minimize the distance and the barriers, which the students need to negotiate in order to interact with me as a person and educator.

Unfortunately, the term "Office Hours" as known from the US educational system is in my experience used rarely in the Scandinavian university system. This is unfortunately, because "Office Hours" has the potential to offer more than just one-on-one assistance with the course material. Research has documented that high-quality student-educator interactions are correlated with student retention, persistence, and academic achievement (Kuh et al. 2010). When used correctly "Office Hours" offers the possibility for the student to get help to see the course material in a larger picture, obtain professional advice, and build confidence and aspirations for further study (Hurtado et al., 2011). Student-educator interaction plays a key role in experience of university. In my future teaching I will therefore continue to develop interactions with students outside the class room. One way that I will do this will be through the use of "Office Hours". However, as "Office Hours" is not a term, which is frequent use in the Scandinavian university system I will place specific emphasis to make sure that students see the potential in "Office Hours". I will also be focused on addressing their understanding of "Office Hours" and evaluate how the form can influence how they use them?

## Bringing students into the world of research

As an educator, one of my missions is to lead students to established and scientific knowledge, to expand their understanding and curiosity by teaching what is known and what is unknown, and to shorten the distance between the scientific discussions in the laboratories and research groups and the student in the classroom. I therefore, both when I am teaching and lecturing, specifically implement examples illustrating how I am using the same techniques and knowledge, which the students are learning, directly in my own research. I place an effort into presenting to the students the open scientific questions, as I have found that showing what scientists do not yet understand will inspire students at all levels.

Through my position as adjunct faculty at Bermuda Institute of Ocean Sciences I have had the opportunity to be directly involved and observe the annually occurring of Research Experiences for Undergraduates semester program (REU) sponsored by the US National Science Foundation (NSF REU, 2021). This program has illustrated to me the possibility of combining education and research and has guided me in including students directly in my own research. Such student involvement has covered data curation and participation in field work. Research has documented that involving students from an early point during their bachelor-degree program has significant positive influence on understanding, confidence, and awareness among students, and have further increased the interest in pursuing a career within science, technology, engineering, and mathematics (STEM) (Russell et al, 2007).

While I have only had the possibility to involve undergraduate students in research through the REU program, I have especially for master thesis students sought to offer the possibility of participation in field work when relevant for their thesis. Currently half of the students, who I have supervised, have participated in field work. When developing the master thesis topic together with the students I have always placed an effort in focusing the thesis towards publishable work. The success of this approach is for example illustrated by the number of peer-reviewed publications, which has come out of master thesis project under my supervision. Out of a total of six theses, which I have supervised, three has resulted in peer-review publications and one more is currently in review.

As highlighted by Russell et al. (2011), involving undergraduate students in research has a positive influence on the aspiration of undergraduate students in pursuing a PhD degree. In my approach to advising master theses, I ensure to bring forward enthusiasm with encouragement to think outside the box. While it is difficult to state more than correlational indication, I am pleased that four out of my six master students have decided to continue with a PhD degree.

In the future teaching and student advising I want to continue to engage students with research at all levels. Based on my own experiences and established literature there is potential for gaining a variety of positive results by developing opportunities of research experiences for undergraduate students further. In my class-room teaching I want to include research data directly in student exercises.

## Becoming thinkers and thinking outside the box

A fundamental teaching and mentoring principle for me is to encourage the individual students to establish ownership of their learning and projects. I therefore see that my role is to train each student to become an independent, creative researcher and thinker. Scientific intuition is only possible to develop if the student is allowed to formulate his or her own questions and problem-solving strategies. Through this process, as active participants in the search for knowledge, students learn the skills needed to develop their own resources for learning and hence become prepared to meet the intellectual challenges of their future career.

In 2018 I had the pleasure of co-leading a group of undergraduate students on an Exploration Seminar to the west coast of Greenland for three weeks. The focus of the seminar was based on the physical science of ice and climate, but discussed through the lens of culture, history, and policy. This educational experience illustrated to me the possibilities of combining physical science and interdisciplinary topics

as an instrument to foster lateral thinking in union with critical thinking. By design, the Exploration Seminar moved the teaching out of the class room and directly into the real world. This created multitudes of fora where the students interacted and exchanged ideas directly with scientists, politicians, Inuit hunters, and interest groups, while at the same time witnessed the influence of climate change on the local environment. It was through these discussions, that the creation of an active deep learning environment was achieved. The role of the instructors was to steer and facilitate the discussions. The students came from both science and social science disciplines. This mixture of disciplines was valuable as we at the end of each day evaluated the thematic problems observed and discussed through the interactions with the local stakeholders. Instead of learning from the educators, the students used each other as resources in group discussions and hence collectively developed a problem-solving strategy.

While being at my core a natural scientist, the observations and experiences made through the Exploration Seminar along the western coast of Greenland have illustrated to me the value of mixing students from different disciplines and taking the learning environment out of the class room. As we are educating the next generation it becomes increasingly important to acknowledge the need for providing the tools for the future leaders and organizers of society to work interdisciplinary. In my future development as an educator I want to strengthen the pedagogic foundation for how university education form whole human beings.

## Self-evaluation

By evaluating my own level as an educator on the five-stage scale developed by Kugel (1993), I identified myself at level four. Through my experiences as an educator I have witnessed the importance of what the students do to enhance their learning. I acknowledge that for students to obtain deep learning from traditional lectures, the students need to activate engagement in the class. Such engagement in lectures can range from student-student discussions, over student-instructor discussions, understanding observations (class-room experiments), to answering quizzes related to the material being covered. As an educator I begin to see myself more as both an expert and a coach for the student whom they can rely on as they develop their own tools for learning. Research as well as own experiences have shown that to obtain a better understanding one of the best tools to use is to teach it to somebody else. As I strive towards becoming a better educator, I want to continue developing student-student learning methods and foster an environment where students become independent learners and thinkers.

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