

Course in University Teaching and Learning 2017/2018

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One plus one equals three: exploiting synergy between UNIS and NTNU EnviTox postgraduate training

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Impetus

The key element that inspired me to continue studying after my undergraduate degree was the practical component of both field work and laboratory experimentation. While UNIS excels in many aspects of field work, our resources, facilities, and expertise in laboratory analyses are limited. The Environmental Chemistry Department at NTNU, however, has extensive expertise in environmental chemistry and incorporates hands-on analytical training in many of its teaching programs, in particular its unique program in Environmental Chemistry and Toxicology program (EnviTox). Within the area of environmental chemistry and toxicology studies in the Arctic, chemical analyses of water, sediments, ice/snow, and air are essential components of the educational training to confirm presence and concentration of most pollutants of interest (e.g. metals, oil and combustion related compounds, long-range transported chemicals, and emerging contaminants). Despite the central role of chemical analysis in teaching and understanding environmental pollution, UNIS currently is unable to incorporate this component into its courses from its own internal resources. The EnviTox and Environmental Chemistry programs at NTNU, on the other hand, are limited in their resource capacity for accessing and sampling the Arctic Environment. By combining the teaching strengths of UNIS and NTNU, we tested a method of addressing these pedagogical gaps of field and analytical resource availability by introducing an active learning component followed by flipped classroom. Two courses were involved; the UNIS AT-331/831 Arctic Environmental Pollution: Distribution and Processes course and the NTNU KJ3073 Analytical Environmental Chemistry course. Both courses ran simultaneously during January and February 2018. In short, this included chemical analyses at NTNU based on samples collected as part of fieldwork in the UNIS course. The students at UNIS had the responsibility to describe the background for the sampling, selected sampling methodology, and do the planning and collection of the samples. The students at the NTNU course on the other hand had the responsibility to carry out chemical analyses and report results. The final stage of the exercise, a joint interactive web seminar following a flipped classroom format was carried out, and the students gave short video-based lectures to each other based on their gained knowledge and activities. This culminated in a joint discussion on interpretation of the results and a conclusion to the exercise.

Method

Student Recruitment

Fourteen students joined the AT-331/831 course (AT-831: 1 PhD student; AT-331: 13 masters students) in January 2018, and 11 of them (79%) were enrolled in either the EnviTox or other chemistry masters programs at NTNU. There is an established route of EnviTox students expanding their experience by joining UNIS Arctic Technology Environmental Chemistry and Toxicology courses, which is why the take-up from NTNU students was so high.

The NTNU KJ3073 is a new master course established in 2017. Over the two start-up semesters (2017/2018), the course has had an average of 18 students including master students from the EnviTox program, the Chemical Engineering and Biotechnology program, and students from the Natural Science with Teacher Education program. Number of students from the different master programs are relatively equally distributed.

The students enrolled for the UNIS AT-331/831 courses that come from NTNU programs are from the same year and pool of students as remain for the NTNU KJ3073 course. This was the case in 2018, and it means that many students were familiar with each other and were friends. Due to the majority of students having NTNU in common, the friendships, familiarity, and contact were shared with the minority of students who were not from NTNU. Further, students following AT-331 in spring semester the first year in their master program will follow KJ3073 the next spring semester. This group of students bring a continuation into the collaborations.

Fieldwork

The UNIS AT-331/831 work planned and led by Øyvind Mikkelsen in his teaching on the topics of metal and organic contaminants in the Arctic, focusing on transport processes between the atmosphere and deposition into snow. It was split into four components. Firstly, the theoretical material was presented in a traditional lecture format and seminar discussions. Secondly, the students were split into groups of three or four and each group had to research a particular theoretical aspect of the topic. The topics they were encouraged to pursue were on Arctic-specific issues of contaminant transport and processes, Arctic environmental chemistry, and field sampling techniques. The students had opportunities to discuss their topics and check they were on the right track with Øyvind, and were given some technical training in filming and presenting their research. This exercise culminated in the students producing their own short video where they presented their focused research, including short films of the actual field sampling. The third component was planning and conducting a field sampling campaign in Longyeardalen. Maintaining the groupings and allocating each group a particular sampling transect, the students then carried out careful snow sampling following the scientific sampling protocol they had been taught. The fourth and final component for the AT-331/831 students was to bring their snow samples back to the laboratory. Some initial measurements were recorded on the fresh samples, and protocols were learned and conducted for fixation and preparation for safe transport to NTNU.

The role of the teacher in the AT-331/831 component was to present the lectures, guide the discussion, and support the group progress. The majority of the time and content was through student-led active learning. Additional work involved compiling the videos and including some basic editing.

Laboratory Analyses

The NTNU 3073 course students received the samples collected by the UNIS course students together with information on the specific organic and inorganic toxicants of relevance for measurement. The KJ3073 course students had then to evaluate and select analytical techniques, prepare samples for the chosen methods, and carry out the actual measurements. The KJ3073 students were divided into groups of three to four students and given individual tasks. The group topics included working in the analytical chemistry laboratory, practical aspects of sample processing, and introducing and demonstrating the analytical methods and instruments for trace element analyses and other contaminants of interest. The outcome of the group work was video presentations over the assigned topic, e.g. argumentations for selected analytical methodology, insight to the used analytical instruments, presentations of results and quality assurance.

Opening Night – combined student seminar

The conclusion of the combined teaching initiative was a scheduled afternoon session with both sets of students, UNIS and NTNU. The UNIS students gathered in the formal lecture hall, and the wider UNIS community were invited to join. The NTNU students were arranged similarly in NTNU. The session started with simultaneously showing the final movie, edited from all the student group presentations, video, and additional footage. The final video was 40 minutes long, and told the complete story from theory of how selected contaminants arrive in the Arctic and how they are transported between different environmental compartments (air, snow, ice, land), to the methods for sampling, processing, transporting, and analysing. The reality of field sampling in the Arctic in January is made very clear in footage of students digging snow in the darkness, and is brought into clear contrast with the light, pristine conditions of the analytical chemistry laboratories in NTNU. The video concludes with a 'bloopers reel' of out-takes with funny mistakes, providing a hilarious end.

After watching the video to guests were invited to leave, and a short discussion was initiated with the students. The NTNU students were charged to think about what they had just seen presented from Svalbard, and to come up with questions they would like to ask the UNIS students about designing, planning, and conducting field sampling for snow in the Arctic winter. The UNIS students were charged to consider and come up with a handful of questions that they would like to pose to the NTNU student regarding the analytical aspects of their work, and how it was to receive, handle, process, and analyse the snow samples. After approximately 20 minutes internal discussions, a skype call was initiated between UNIS and NTNU. Finally, both sets of students were face to face, friends could laugh with each other, and new people were introduced. The students asked and responded to questions, and could teach and learn from each other. This open discussion conference lasted approximately 30 minutes.

Pedagogical outcome and considerations

Within the limitations of time and resources available to the respective UNIS and NTNU courses, this combined teaching exercise was able to maximise the learning outcomes for all students by engaging both directly and indirectly (via peer-to-peer learning) with aspects of both field work and laboratory analyses. The used pedagogical tools were active learning based on problem-based learning and flipped classroom. This also included the integration of information and communication technology (ICT) in the teaching. The potential for video peer-to-peer learning to increase active engagement has been demonstrated with success particularly in complex interdisciplinary science topics (Pfennig & Hadwiger 2016), and lends itself well to the complexity of a masters/PhD level

course in Arctic environmental processes and transport. In consideration of the taxonomic categories proposed by Fink (2013) in striving to achieve 'significant learning', this exercise links the left-side aspects of personally engaged and caring students directly to the right-side aspects by guiding them to teach each other the background scientific knowledge, interpretation, and context. This is achieved largely by stimulating the students' creativity, allowing them to apply their often highly-developed 'modern' skills in video making and story-telling to the scientific learning context. The exercise proved to be a lot of fun to the students, with clear additional transferable skills developed in communication and multi-disciplinary management. By allowing the students to direct their own videos and be responsible for their particular chosen topic to their peers assured a feeling of autonomy and internal motivation and responsibility that is so central to the self-determination theory within higher education (Niemi & Ryan, 2009).

An important characteristic of UNIS masters/PhD level course is their restriction in class sizes to a maximum of 20 students. This lends itself to close contact between teachers and students, which can increase personal engagement. However, the laboratory facilities available to even such small class sizes are inadequate and typically laboratory sessions involve split and repeated classes which greatly reduced the extent of the teaching material and topics able to be covered over the few weeks duration of the short courses. By splitting the field work and laboratory analyses components between two different classes, there was a clear benefit by providing each class with more time to spend on each component. From the UNIS side, teaching time could be spent on considering aspects of field work design and planning, and the careful protocols for sample handling, fixation, and transportation could have more attention and be learned at a higher level. These aspects are often overlooked or deprioritised in favour of the final laboratory analyses, data generation, and data interpretation. These latter aspects were delivered by peer-to-peer learning, in addition to being available to those students returning to NTNU for further studies. As such, the structure of the exercise is ideal in the particular context of short specialised UNIS courses delivered to students enrolled within EnviTox or other NTNU environmental courses.

The exercise conducted in January 2018 was a trial run that was observed to be very successful in terms of student enjoyment and engagement, and appeared to be successful enough to warrant repetition in the planned course for 2019 and beyond. However, improvements are needed to suitably evaluate its success from a learning outcomes perspective, and further efforts should be made to improve course alignment and consider the place of the exercise within the learning outcomes and the assessment, following the SOLO guidelines outlined by Biggs (1999). The plans for repeating the exercise in 2019 are to include a student survey focused on their experience of the exercise in order to evaluate the benefits to their learning. Following an appraisal period after the 2019 course, it is possible that the exercise be included in the formal assessment for the course and amend the alignment between teaching content and assessment.

References

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