STINT Teaching Sabbatical 2024 - Final Report

School Physical and Mathematical Sciences
Nanyang Technological University
Singapore

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1. Preparation and planning

Initial contact

I contacted both my academic and my administrative contacts already in January 2024, with the intension to organize a planning visit, to get started with the VISA application, and to apply for housing. It soon turned out that NTU would not be able to arrange an apartment for me, as ongoing construction work for the new subway running through the campus had created a housing shortage. I therefor added the task of arranging housing to the list of things to look into during my planning visit.

I got very positive replies from both my contacts and we agreed that I would make a visit in April to plan the sabbatical. Concerning the VISA application, I learned that I had to apply for at Employment Pass from the Singapore government and my administrative contact helped me to fill out the correct forms.

Planning visit

With the intent to plan my teaching sabbatical I visited Singapore for little over a week between Mars 29 and April 7. I was well received at the School of Physical and Mathematical Sciences (SPMS) and was given a visiting professors office. However, I already then realized that my colleagues were very busy, and that it was almost impossible to casually interact with anyone. To meet with the teaching staff at the school, even with my academic contact, I had to e-mail my administrative contact and ask her to set up a meeting. During my stay, I had two meeting with my academic contact who, turned out to be the Director of studies for Physics, A/Prof Heong Siew Ann. I got an introduction to the School in general, and to the organization of the teaching. We also discussed my teaching interests and he helped me to arrange meetings with some of the teachers.

From A/Prof Heong I learned that the physics program at NTU has about 200 applicants for 75 spots, which is similar to the physics program at Uppsala University (UU). The program, however, is a four-year bachelor program, while Uppsala university offers a three-year bachelor program followed by a two-year master. The academic year at NTU is divided into two semesters of 17 weeks each. The teaching is distributed over 13 weeks, while three weeks is devoted to revision and examination, and one week is a mid-term recess week. The size of a course is measured in Academic Units (AU), where 1 AU correspond to one hour of lecturing per week of a period of one semester. Typically, students take 16 AU per semester but it can vary. After four years of study, the students have typically gathered 130-160 AU worth of courses. However, to obtain the degree, only 77 AU of graded courses are required. Hence, the students can choose which of their courses to include in the degree. The non-graded courses can be regular NTU courses, but it

can also be, for example Massive Open Online courses offered by other institutions, or courses taken abroad in the scope of exchange studies. Furthermore, apart from taking courses in their field and related fields, all students at NTU are required to take seven Interdisciplinary Collaborative Core courses at a total of 17 AU. These courses are, for example, courses on sustainability, ethics and healthy living.

Early on, I realized that no one in the department shared my research field, and as a result, very few advanced courses were available in my area of study. However, I connected with Prof. Sum Tze Chien, who taught the department's only course in nuclear physics. Fortunately, he was eager to have me on board. We agreed that I would cover for him during one of his trips by delivering a lecture on nuclear fission and another on nuclear fusion.

Apart from meeting with my future colleagues I also took the opportunity to explore the campus and potential neighborhoods to live in.

2. Tasks and responsibilities

Upon arriving in Singapore, I still did not know much about what I would do, except for the two lectures in nuclear physics. I was given an office for visiting professors, but, as I did not have a contract with NTU, my email account was not on the regular email lists. This meant I had to rely on my administrative contact to forward important information, for example on pedagogical seminars and meetings.

To become more engaged in teaching, I emailed all the staff at the school, introducing myself and the STINT teaching sabbatical. I expressed my enthusiasm for contributing to teaching development and encouraged them to consider me a resource for any new ideas or initiatives they wanted to explore. The response I got was from A/Prof Elbert Chia, teaching first year mechanics to students at the bachelor of physics program. In his course he had an elective advanced tutorial group for students who wanted an extra challenge. This year however, he did not have anyone to teach these tutorials. Although this was not exactly what I was hoping for I saw this as an opportunity to meet students and get insights into the teaching practices at NTU. Upon meeting with A/Prof Elbert, I learned that there were actually two teaching positions that needed to be filled: One for the advanced tutorial and one for a regular tutorial group. After some consideration I decided to accept both.

My first week at NTU was the orientation week for new students and I participated in some of the activities. For example, I sat-in on a lecture by A/Prof Heong where he introduced the new students to NTU and SPMS, see Figure 1. I was also invited to attend a mentoring session where new students and met with faculty serving as mentors.

*Figure 1: Me attending the **Introduction to NTU**-lecture by A/Prof Heong.*

During my first week at NTU I also learned about the course Physics A. This is an A-level physics course that is mandatory for all students at the engineering programs at NTU. This triggered my interest because of the huge number of students, over 1200, that take this course every year. I also met with one of the teachers on the course, A/Prof Justin Song Chien Wen, who invited me to sit in on his tutorials, and to attend the meetings organized by the course responsible teacher, Dr Ho Shen Yong. I later learned that Dr Ho is also the Executive Director of the Institute of Pedagogical Innovation, Research and Excellence (InsPIRE) at NTU.

3. Activities during the Teaching Sabbatical

Mechanics

My main obligation during my sabbatical was the teaching of the two tutorial groups in Mechanics. I met with each group one hour per week. The regular tutorial had an attendance of approximately 30 students, while the advanced sessions were visited by about 10. Prior to these meetings the students were given a sheet with problems to solve and my instructions were to show the students the correct solutions to these problems. Having a social constructivist view of learning, I am a firm believer in student activation and collaborative work in the class room. I was therefore thrilled to learn that the regular tutorials, as most tutorials I later learned, were scheduled to be held in an active classroom setting, where the students are seated in groups around

small tables that all have their individual whiteboards. This arrangement makes collaborative work much easier as the students can work on the problems in their respective groups, and use the white boards to write down their solutions. Unfortunately, the advanced tutorials were scheduled in a normal lecturing hall, but I decided to still make my best to activate the students.

For my first tutorial I had created a set of activating exercises. I had also created quiz-questions, using Wooclap (NTUs online students' response system), to probe the students understanding. I had been warned that Singaporean students would be shy and quiet, but was happy to find out that they were not, at least not more than Swedish students. I thought the session to be successful, but, as anticipated, I did not manage to cover all problems due to lack of time.

The day after the tutorial I got an email from A/Prof Elbert. He had been contacted by a group of students who were concerned about the fact that I hadn't covered all problems. The students wanted to have all the solutions in case something similar showed up on the exam. A/Prof Elbert did not what to hand out written solutions to the problems as those could spread to next year's students. Instead, I promised to try to catch up next week.

The following week, I decided to forgo all interactive exercises and focus solely on presenting the solutions. However, I couldn't resist occasionally posing Socratic questions. As a result, I managed to catch up on the previous week's problems and address most of the current week's issues. A/Prof. Elbert also agreed to let me create video recordings for the remaining problems. This experience taught me that the tutorial sessions were intended to be more of a one-way communication from teacher to students rather than interactive and collaborative.

In addition to leading the tutorial, I also observed several lectures by A/Prof Elbert. They were all highly inspiring, and it was clear that he is a dedicated teacher who genuinely cares about his students' learning. He consistently incorporated active teaching methods, such as pair discussions and Wooclap. However, I felt that more in-depth group work was limited by both the physical constraints of the lecture hall and the course's demanding syllabus.

On a few occasions, I assisted A/Prof Elbert in designing problems for the midterms and final exam. I also held office hours, where students could ask questions or discuss their solutions to the midterm problems.

Physics A

Through A/Prof Justin I got invited to the meetings between Dr Ho and the co-teachers of the course Physics A. These were weekly meetings in which Dr Ho presented the problems he wanted the teachers to cover, and which activating and collaborative exercises he though was best suited for each problem. The tutorial

teachers, on the other hand reported how the exercises of last week had turned out and gave their view on the upcoming weeks problems. It was interesting to observe the collaborative environment these meetings created, and to take part in the pedagogical discussions that arose. Like in the mechanics course, there was often a conflict between the amount of material to cover, and the time spent on student activation. Dr Ho was often pushing for more activating teaching while the co-teacher objected that time was limited. This commonly resulted in a reduction of the number of problems to cover in the tutorial in benefit of more activation.

Through these meeting I also got the opportunity to substitute for A/Prof Justin in two of his tutorials. The setting was very much like the tutorials in the mechanics course with about 30 students divided between seven round tables. The difference was that in this setting there was actually enough time to engage in student activating exercises and discussions (see Figure 2).

Figure 2: Engeneering students engaged in problem solving.

I also attended a few of Dr. Ho's lectures in the Lee Kong Chian Lecture Theater, a hall that accommodates up to 1,000 students. It was inspiring to see how, despite the large audience, Dr. Ho managed to engage his students, keeping them captivated

while actively involving them through Wooclap and bee-hive discussions (see Figure 3).

Figure 3: Dr. Ho giving a lecture on buoyancy for 1000 engeneering students.

Nuclear physics

In the fourth-year **Nuclear Physics** course, I was invited to deliver two lectures related to my research on nuclear fission and fusion. Each lecture was structured as two 45-minute sessions, similar to the format of my lectures at Uppsala University. It was a great opportunity to teach one of my favorite topics, and afterward, I had lunch with a student who was interested in pursuing a career in the European nuclear industry.

I also constructed a problem for the hand in examination of the course, using data from the Jezebel experiment.

Miscellaneous

Apart from teaching, I also took part in a number of other activities. One example, is the OneNTU-day, an open campus day for faculty, students and their relatives. I also met with the staff at The Centre for Teaching, Learning & Pedagogy (CTLP) to discuss pedagogical development, and what pedagogical education NTU offers their teaching staff. As a result of these discussions, I was invited to participate in one of the classes offered to new teachers.

Another possibility arose from discussions Prof. Lena Öhman, a fellow STINT scholar at the Lee Kong Chian School of Medicine, NTU. Lena introduced me to Team Based Learning (TBL), a teaching method that is used at the medical school both at NTU and in Gothenburg. Through Lena I got in contact with a few of the teachers at the school and got invited to attend one of their TBL sessions. In short, these are active learning sessions tailored for large student groups. To facilitate this the sessions are very strictly organized. The students are seated in small groups around tables. The sessions start with a set of multiple-choice questions that the students answer individually in order to test their understanding. The students then get to discuss the questions and resubmit their answers as a group. Finaly, the questions are discussed in the how class and the discussion is moderated by experts in the field. Figure 4 shows a photo from the Active Leaning Classroom (ALC) and the session I participated in.

Figure 4: TBL-session with students from the medical school in an ALC accomodating more than 240 students.

4. Comparison between the host and the home institution

The most striking thing to me when comparing how physics is taught at NTU and UU are the similarities. It seems like there is a universal system with lectures, tutorials and lab exercises making up close to 100 % of the teaching activities.

Lectures

Lectures are typically monologues delivered by the main instructor of the course. However, there are exceptions, and both Dr. Ho and A/Prof Elbert stand out as

educators who actively engage their students. Nevertheless, the physical constraints of large class sizes - 70 and 1,000 students, respectively - pose significant challenges. Traditional lecture halls, where students sit in fixed rows of bolted seats, further limit opportunities for collaborative learning.

At NTU, a few large Active Learning Classrooms (ALCs) can accommodate over 200 students, but most lecture halls follow a conventional design. Similarly, at the Ångström Laboratory, where I usually teach, most lecture spaces are traditional, with the largest ALCs accommodating only around 70 students.

Tutorials

Tutorials are typically taught in smaller groups of about 30 students. At the physics department at Uppsala University most tutorials are taught in traditionally furnished classrooms which does not invite student collaborative work. At NTU, on the other hand, most tutorials are scheduled in ALCs. However, judging from my experience the advantage with having ALCs is not fully utilized at NTU.

Laboratory classes

At UU laboratory exercises are typically an integrated part of a course. For example, when students take a 10-credit course in mechanics, 2 or 3 credits are typically lab classes. On the other hand, at NTU laboratory exercises are isolated to a stand-alone laboratory course, and students typically have one of these courses per semester. In my mind, there is no advantage to this system and it has the risk that laboratory exercises become isolated from the theory, instead of the two leveraging each other.

IT in teaching

One of the aspects that impressed me most about NTU is how advanced they are in integrating technology into their teaching practices. While UU has only recently adopted Canvas/Studium, NTU has been using the learning management system Blackboard for quite some time - and they have even developed and integrated their own functionalities into it.

For example, all lecture halls are equipped with automated video recording systems that capture lectures and upload them directly to the course page on Blackboard. Additionally, NTU has integrated Wooclap with Blackboard, allowing instructors to track individual students' responses to in-class quizzes and even use the data for grading purposes.

Through my involvement in the **Physics A** course, I had the opportunity to test an AI-supported grading tool currently being evaluated at NTU. Instructors face the enormous challenge of grading 1,200 written exams, and this tool is designed to streamline the process. The AI system groups students' answers to a specific question based on similarities in their solutions. This allows instructors to grade one group at a time and even batch-grade identical responses, significantly reducing the time required for grading while maintaining consistency.

Grading

Compared to the Swedish system, student grades are much more important in Singapore. NTU uses a 5-step system (A, B, C, D, F) with intermediate steps (+ and -) that is later translated into a numerical value used to calculate a grade-point-average (GPA). This GPA can later determine your salary when you apply for a job.

While the Swedish system is, at least in theory, absolute and knowledge based, the Singaporean system is relative, and there are unspoken rules about how large fractions of students should get each grade. To pass a course at Uppsala University a student has to show that they have reached all the goals specified in the syllabus. This sometimes results in more than half of the students failing a course. At NTU, on the other hand, due to the relative system, the fail-rate is only 2-3 %.

5. Important lessons

The most important lesson I have learned from a pedagogical point of view has to do with pedagogical leadership and use of recourses in connection with active learning. Higher educational institutions, and this is true for both NTU and UU, tend to consider lecturing the most important and difficult pedagogical task. As a result, this task is typically given to the most experienced and well-trained instructors. The problem is that lectures often are conducted in front of a large group of students, in a lecture hall that does not promote active learning. On the other hand, tutorial sessions and laboratory classes, that are much more suited for active participation of the students, are commonly taught by less experienced instructors like post-docs, PhD-students, or even second cycle students. These instructors often have very little to no training.

I consider myself a fairly experienced teacher with a strong understanding of effective pedagogical practices, so I found it frustrating to be in a situation where I had the physical means to implement these practices but was constrained by an overwhelming amount of material and too little time.

Although the discussions on active learning during the Physics A teacher meetings were inspiring, the actual delivery of these methods was largely left to less

experienced instructors. I firmly believe that the current approach - where the most experienced instructors primarily handle lectures - needs to be reconsidered. If we truly value active learning and recognize the importance of student engagement and social interaction, we must ensure that our best educators are working more closely with students, rather than being distanced from direct teaching.