

This issue of CDTL Brief features articles based on select presentations at the Teaching Workshop on Freshman Seminars conducted by the Faculty of Science on 22 April 2009.

Freshman seminars provide an unparalleled opportunity for first-year students (freshmen) and faculty to explore a scholarly topic of mutual interest together, in a small group setting of about 15 students. Designed with freshmen in mind, students' intellectual curiosities are sparked as they are orientated into becoming an active member of the NUS intellectual community. Faculty benefits too from interacting directly with a handful of bright and talented new students, which can be inspiring and energising. Obviously, senior students could also benefit from such seminars. In addition to fostering an exciting intellectual environment, the close interaction and early building of rapport between students and staff in these seminars is expected to set the stage for mentoring relationships that could extend to later undergraduate years.

Looking forward, freshman seminars will become an important learning component of residential life in the University Town. ■

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Deputy President (Academic Affairs) and Provost

Freshman Seminar: A Forum to Learn More by Teaching Less

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Many of us tend to 'over-teach' because it is very tempting to subscribe to the notion that the more we teach, the more students can learn. This is obviously a misconceived notion because the learning outcome is determined by a complex mix of factors and the amount of materials we dish out is hardly a gauge of our effectiveness in teaching, let alone learning. Let us not forget the basic rule of education—teaching can only be as effective as learning permits.

We can all learn from the science of chemistry here. The yield of a chemical reaction is not only determined by how much substrates it consumes, but also by how the reaction conditions are optimised. There are many reactions with 100% consumption of reagents but very poor yields of products. In the classroom, this is translated into poor learning outcomes because of a disconnection between teaching and learning, and the less-than-conducive environment. This is where the freshman seminar can make an impact.

Students generally learn best when they are (a) motivated, (b) inspired, (c) engaged and (d) challenged. We can put these into practice in these seminars.

I have conducted two freshman seminars since the programme was launched: “The Artistic Molecules and Molecular Art” and “The Five S’s of Molecular Science”. They have one feature in common—the use of molecules to motivate learning.

The most valuable teaching materials are often those that matter most to our lives. Molecules in all shapes and sizes are present everywhere. Without them, we cannot live. Yet, if we come into contact with the wrong ones, we are dead. The irony of these statements provides a great driving force in motivating even the most “unmotivatable” students. The seminars give us an opportunity to introduce a myriad of activities that help students overcome the kinetic barrier of learning.

Inspiration is the best catalyst for knowledge acquisition and application. Different students get their inspirations from different sources. They are also inspired by different modes of teaching. The freshman seminar gives one a the chance to know each student and take a personalised approach to meet individual needs.

One of the biggest challenges facing teaching and learning in NUS is the large classes, impersonal environment and the ‘free size’ curriculum. These are by no means unique to NUS but the common side-effects of any large comprehensive national or state university. Every challenge creates an opportunity. By injecting some ‘fresh air’ into a ‘boutique education’ within a comprehensive structure, we can seize the opportunity and make a real difference here.

Researchers take pride in their new discoveries and creation of new knowledge. An inspirational teacher can offer new insights that can help students grasp difficult concepts. Inspirational teaching is not about delivering a highly organised lecture or one that is delivered by a charismatic professor. It is about offering insights and perceptive ideas that make learning enjoyable and enriching. Learning molecular chirality is such an example. It is a topic that even

a chemistry major would find difficult, let alone novice students in the heterogeneous freshman seminar class. Yet, there are many examples in life that can inspire such learning; cutting dragon fruits is one of them (see Figure 1).

Is it too hard to differentiate “homochirality” from “heterochirality”, or “diastereomers” from “enantiomers”? How about taking on a challenge to cut a dragon fruit so that two halves are the same and yet not the same? Or cutting two dragon fruits in the same yet not the same way? Sounds mind-boggling? My students had hours of serious fun doing it.



Figure 1. Appreciation of the concept of homo- and heterochirality through cutting dragon fruits.

Teaching would never be effective without engagement. Why do our students need to attend our classes if they can learn everything from textbooks, literature, the Internet and so on? The key and the difference is engagement.

The small group setting of freshman seminar provides an ideal opportunity to engage the students on a one-to-one basis. My typical freshman class comprises 50% of chemistry major, 25% of life science major and 25% of other majors such as physics, mathematics and statistics. The heterogeneity presents a formidable challenge to any professor in a big class. In the freshman seminar however, it presents an ideal opportunity to practise personalised teaching. Every student is different and each requires a special approach to maximise the learning outcome. This can only be achieved if we make a serious effort to engage individuals in the class.

Engagement requires more than personal attention. It is a chance to introduce different activities in and outside the classroom including projects, essays, field trips, literature review, presentations and teamwork. One will find that different students respond to different situations and demands, and the mindset of ‘weak’ or

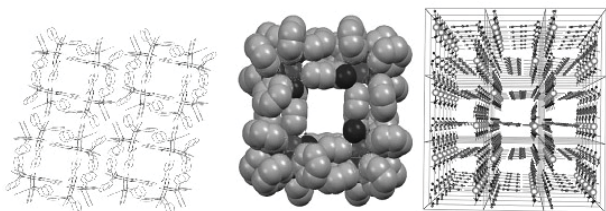


Figure 2. Porous materials developed in the research laboratory of the author.

‘strong’ students will change as soon as the class is put through different challenges. I have not met a student in my 25 years of academic life who is strong in everything or weak in everything.

Students can be classified according to four levels of abilities: (a) gifted, (b) admirable, (c) competent and (d) inadequate. The bottom-line of a professor is to transform an inadequate student to become a competent one and to stretch the potential of students regardless of their abilities. This requires patience, skill and resourcefulness. One will never be considered as an adequate professor if one fails this challenge.

Chemistry offers another example to show us how we can approach students of different abilities. Take for example a simple 3-step reaction: $A + B \rightarrow \dots \rightarrow \dots \rightarrow C + D$. An inadequate student would struggle to get the answer of “C + D”. A competent one would get this, but unable to explain why it must be “C and D” instead of “X and Y” or whatever. An admirable one can go beyond the basics by offering an alternative pathway such that $A + B \rightarrow C + D$ takes place in one step. This is an academic challenge that is industrially relevant.

With a group of gifted students, one should challenge them to propose a single-product reaction (condition) such that $A + B \rightarrow C$ when the formation of D would be undesirable. This would then become a molecularly economised equation and a model process of our future chemical and pharmaceutical industry. Freshmen seminars thus allow us to introduce contemporary concepts to the class in an informal atmosphere. The horizon of learning is thus expanded, not by the quantity of the teaching materials but by approaching the materials from a fresh angle.

It is relatively easy to bring ‘hot-from-the-oven’ research findings to the classroom. This

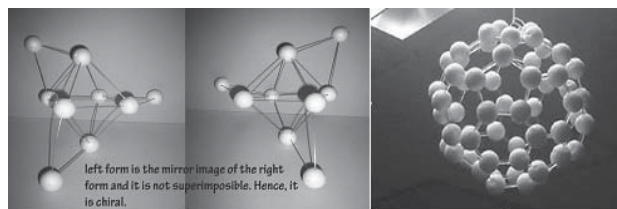


Figure 3. Home-made “molecular models” built by students as a means to learn chirality and symmetry.

is where education and research intersects and how even the most gifted students can be intellectually challenged. A good example is the concept of molecular assembly. It is natural for materials scientists to introduce to students ideas of Molecular Porous Materials (MOM), Porous Organic Materials (POM) and Molecular Organic Framework (MOF) (see Figure 2). These materials are good illustrations of the essence of the five S’s (Shape, Space, Structure, Symmetry and Science) of molecular science, and are taught as advanced topics in a standard chemistry curriculum. Yet, when these are shared in our seminars, students would be surprised at their own ease of absorption and assimilation.

Molecular symmetry is another essential concept in chemistry, but it is rarely possible to introduce it to freshman classes. The freshman seminar is an exception. There is an easy way to learn symmetry through molecular models and daily encounters (see Figure 3). This is another example of how we can lower a learner’s kinetic barrier. When we further link symmetry to molecular origami, it is not difficult to see why we are getting some delightful responses from the students.

Freshman seminar is an experience not only for the students, but also the professors. It provides an ideal forum to build rapport and trust between faculty and students. This form of experiential teaching lets us exploit our desire to influence how our students should approach knowledge acquisition, integration and application. This is achieved not by over-indulgence in the process of knowledge transfer, but by sharing the different mechanism in knowledge dissection, assimilation and creation. If the freshman seminar can impose a positive influence on the subsequent learning and development of our students, we would have every reason to rejoice as a faculty member. ■

FSE1202: Great Discoveries and Inventions

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Summary of the aims and format of the FSE1202 module

A new freshman seminar module in the Faculty of Engineering, FSE1202 “Great Inventions and Discoveries”, gives students opportunities to carry out their own case studies on innovation and conduct their own experiments. The course engages students by taking a hands-on/historical approach in learning fundamental scientific/engineering principles—an approach which has already been reported at the NUS,¹ and which has been promoted by the creation of an intranet website supported by CDTL.²

The module centres around discoveries and inventions in the history of electricity and magnetism—a subject related to the present lecturer’s (A/P A. Khursheed) expertise. Topics covered in the first four weeks include electrostatics between 1600–1800, invention of the battery and the impact of the Oersted effect with emphasis on the rise of electric motors between 1820–1840.

Lectures in the first four weeks of the course comprises case studies on pioneers of modern science, and classic experiments/discoveries made within a certain engineering discipline such as electricity and magnetism. Basic scientific/engineering principles are introduced through historical stories to put students in the original inventor’s frame of mind. Students are given a historical problem or episode and asked: “what would you do?” The lecturer then compares students’ answers to what actually happened. Gradually, an interesting historical story in which students play an active part unfolds. At the end of the lecture, the lecturer performs several experiments to recreate different aspects of the historical episode under discussion using simple, readily available materials. Each week, students make their own simple experimental recreations and present them during tutorials.

After four weeks of lectures and practical weekly assignments, the class is divided into teams of two or three students. They are then asked to prepare ‘the lectures’ by making up their own case study presentations. Each team is given a different historical episode and assigned a different topic in a related theme. They are also requested to submit an electronic version of their case study. After the presentations, each team makes a practical demonstration/experiment related to their case study. The lecturer works with each team to improve their case study. Students typically finish the module by giving a poster presentation of their devices/experiments at a science fair that is open to a wider audience.

Demonstration: Electroscopes made from simple, readily available materials

An example of a device discussed in the second week of the course is the electroscope (see Figure 1). The electroscope is a good example of how recreating an important historical invention/instrument can aid students’ understanding of fundamental scientific/engineering principles. As the world’s first electricity measuring device invented over 300 years ago, the electroscope can quantify static charge imbalance and has



Figure 1. Photo of an electroscope used for demonstration purposes during the lecture made by the lecturer using simple, readily available materials such as aluminium foil, a paper clip, a glass bottle and brass door knob.

great importance in the history of electricity. It is however, something that most students of electricity only read about. By getting engineering students to make and test an electroscope, they are able to see and experience Coulomb's electric force in action.

Normally, engineering students only learn about the electric force through complicated diagrams and formulae. When students recreate the electroscope, they become aware of many more effects beyond the ideal electroscope found in textbooks. In fact, most students' homemade electroscopes did not work the first time. They subsequently learn, usually by troubleshooting in class, that humidity is an important factor in the experiment. Later, through presentations/discussions in the tutorial, they learn that there are simple and effective ways to reduce humidity. They also learn about the effects of many other design parameters such as the shape of the top conductor, the size of the aluminium foils and so on. In this way, students are able to see basic scientific/engineering principles in action through experimentation. During the first four weeks, the lecturer typically presents over 20 homemade experiments/devices to the class using historical case studies. The class then recreates these experiments/devices by themselves as weekly assignments.

Another example of a classic device in the history of electricity and magnetism for the FSE1202 class is Alexander Graham Bell's liquid microphone (1876). Figure 2 shows a photo of a liquid microphone recreated by a student by mounting a paper funnel mounted on to a wooden frame. A copper wire attached to a stiff paper membrane below the funnel is suspended over a vinegar solution contained in a small copper cup, so it just dips into the solution. A battery makes connections with the membrane and cup so that a small electric current flows through the vinegar. When someone speaks into the top paper funnel, the sound vibrations modulate the electric current, which is subsequently amplified by a laptop or Walkman. This device has an intriguing history behind it and while it can be recreated using simple materials, it requires one to learn many valuable engineering principles in order to make it work.

Like the recreations of the devices, students' initial case study presentations are extremely poor. Not



Figure 2. A student's recreation of Bell's liquid microphone—the world's first microphone.

knowing how to narrow down to a specific issue or historical episode, many students simply copy and paste chunks of secondary information from the Internet without first critically evaluating the information. They also do not know how to cite information and use primary sources. However, in subsequent consultations with the lecturer, students revise their initial case study presentations and learn to improve them. In most cases, the final poster presentation is a great improvement compared to the initial case study presentation.

In general, all engineering disciplines have a large array of classic experiments that can be recreated and linked with intriguing historical stories. Experience has shown that it is important to let students make up their own experiments and case studies freely without too much intervention. Thus in FSE1202, students are free to select a case study/experiment from a list or suggest one of their own. Most students are often too ambitious; they commit themselves to carry out experiments that are either beyond their competence and experience or involve the use of materials that are difficult to obtain. Although most experimental presentations do not work or at least, perform badly initially, students are usually motivated to improve their own experiments. Hence it is best for the lecturer to act as a guide on the side rather than a sage on the stage.

Endnotes

1. A. Khurshheed, (2005). Teaching engineering fundamentals by using a hands-on/historical approach. *CDTL Brief*, 8(1). Retrieved 10 September from <http://www.cdtl.nus.edu.sg/brief/v8n1/default.asp>
2. See Beginnings of Electricity and Magnetism—A Recreation. <http://courses.nus.edu.sg/course/eleka/elecsmagnet> ■

Freshman Seminar Module: A Mathematical Experiment

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A blank slate

When the idea of a freshman seminar module (FSM) was first introduced in AY 2006/07, it was novel to NUS. To me, it was not just about teaching a new field which we can readily find books and material to lecture on. FSM does not seem to be well-defined. It has no specific syllabus and no prerequisites. It practically starts with a blank slate. The freedom from the constraints of a highly structured regular curriculum gives the lecturer a sense of naïve optimism that he can now try out some of his pet ideas about teaching that could not possibly be implemented in a regular curriculum.

I started by asking myself what would be my primary objective in teaching an FSM? Clearly, it is not a module meant for students to attain a certain level of competence in a specialised area. Rather, I thought that it should give students a foretaste of learning mathematics, if only at a superficial level. In addition, it should foster ‘out-of-the-box’ thinking among students.

So, what are students’ expectations? I suspect that most students perceive FSM as a ‘soft’ module, but there could be some who are expecting something novel and flexible, or even something exciting and fun. Whatever their expectations, students would be naively enthusiastic.

Making learning fun

Formal mathematics has always been perceived as dull and demanding. A distinguished research mathematician and educator Pòlya (1957) said, “Mathematics, besides being a necessary avenue to engineering jobs and scientific knowledge, may be fun and may also open up a vista of mental activity on the highest level” (p. ix). Pòlya underscores the role of heuristics in mathematical problem-solving. Mathematical discoveries are

often made by analogy with other known results in mathematics and physics. The necessary rigour is often established later.

Another powerful driving force behind mathematical creativity is intuition. Starting as a leap of faith, intuition is often pursued to its logical conclusion to produce breakthroughs. When intuition based on conventional viewpoints leads to a blind alley, its antithetical companion, counter-intuition is often invoked to break out of the impasse.

It occurred to me that these two powerful approaches could be used to learn about the development of mathematics in an interesting way. A seminar module can be spawned by searching for examples of analogy and intuition (and counter-intuition) in modern solutions of classical problems dating back a couple of thousand years ago and in the creation of new fields with surprising subsequent consequences for other fields.

I also thought that freshmen should soak in the flavours of analogy, intuition and counter-intuition in as many areas of mathematics as possible before preconceived ideas and prejudices begin to seep in. Depth will have to be sacrificed in favour of breadth. With sufficient breadth, however, students will be able to trace some of the common strands linking different areas. In the process, I hope they will catch a glimpse of the history of ideas and of the faces behind these ideas. Mathematics will then come alive as a historical and social development.

Thus, the philosophy and approach of the module is to look at the big picture, not the devilish details, and to experience the spirit of enquiry of a universal mental enterprise. One learning outcome of an FSM would be the realisation that ideas are not static and that no idea is an island.

Thinking out of the box

Though the mandatory class presentations trained students to become independent in sourcing and organising information, there was little participation from the audience during the presentations even with my encouragement. However, there was one semester where some student presenters took the initiative to engage the audience by giving out simple problems and getting the audience to participate in the exercises.

I realised that I had to find a way of getting students to participate actively in class and, more importantly, to think critically. With a fixed syllabus, students' thoughts tend to revolve around solving tutorial problems. Without a fixed syllabus, any questions or problems for class discussion will have to be general and not confined to anything too specific.

I found that solving puzzles requires an unconventional approach akin to thinking out of the box. Solving suitably chosen puzzles not only injects fun into the lessons but also gives one a sense of satisfaction. Even if one is unable to solve it, one will be amazed at and sometimes amused by the simplicity of the solution. In a way, puzzles encapsulate research in miniature.

In order to foster 'out-of-the-box' thinking among students, each seminar session would constitute student presentations (with most of the discussions initiated by me) and solving puzzles which I selected. These included logical, geometric and number puzzles that can be solved with elementary mathematics. The class is given some time to think about the puzzle, and the solution is presented to the class by a student. For

harder problems, I would give hints to stimulate discussion. If no student comes up with any solution, I would provide the solution and explain the problem-solving heuristics involved.

What about the future?

FSM has only just taken off at NUS, but it is never too early to talk about its future. For my own FSM, the avenues for hands-on learning experiments, simulations, games, tricks and so on in mathematics are waiting to be explored. We are limited only by time and our own ignorance. In my view, FSM should be more informative than didactic, more informal than formal, convey more fun than pedagogy, generate more inspiration than 'perspiration', promote more awareness than expertise, and foster more curiosity than rote learning.

Not all students will pursue research careers; many of them will become entrepreneurs, managers and policy makers. Long after they have forgotten the esoteric details of the great theories, I hope that this FSM will leave them with an unforgettable impression of the indomitable spirit of enquiry of the human mind and the relentless energy that drives research. Who knows what positive effect this may have on some of the crucial decisions they will be making in the course of their future careers?

Reference

Pölya, G. (1957). *How to Solve It* (2nd ed.). Princeton, N.J.: Princeton University Press. ■

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Promoting Individual Learning Through Small Classes

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For decades, Japan's Yutori education, which means 'relaxed education' or 'education free from pressure', has led to an education crisis characterised by students' declining academic abilities. A major revision of teaching guidelines in the 1970s and active university reform in 2002 transformed Japan's national universities into independent national corporations in 2004. This allowed research/education budgets for universities to be more competitive and introduced financial support for Ph.D. students, while reforms in undergraduate education began to consider the 'gap' between high school and university seriously. In the following sections, I shall attempt to present what the School of Science at Osaka University has done in the last 10 years on freshman-year reforms to provide a more individualised education using smaller classes to encourage every student to study, think and view the world as individuals.

The School of Science at Osaka University is a small undergraduate school with a student enrolment of 260 per year and 218 teaching faculty members for undergraduate programmes. Classes are generally small with 25–60 students in each programme, while first-year foundation course classes have 70 students at most. All departments welcome their freshmen by taking them on the **Freshman Retreat**—a two-day excursion during the first few weeks of admission. The retreat's main objective is to engage students in discussions with faculty members and help students transit from the rote learning mode in high schools to a different academic culture in the university.

Once classes begin, students are gradually exposed to small-seminars/programmes that are often sandwiched between relatively larger classes. This ensures that students will not be overwhelmed by anonymity, but remain inspired



Figure 1. Small-sized seminars/programmes offered by the School of Science, Osaka University.

and stimulated. There are six such programmes (see Figure. 1). However, given space limitations, I will focus on only two programmes.

Basic Seminars for Freshmen is a university-wide programme that offers a total of 304 seminars annually to 3,200 freshmen. Although not compulsory, most freshmen irrespective of their majors, take at least one such seminar of their choice for 90 minutes each week in the 15-week semester. For example, a science major student may take a seminar on "Shakespeare and his love" and a literature-major student may take "Immune systems" or vice-versa. In addition, these seminars expose students to heterogeneous student groups from science, engineering, humanities or sociology and so on. Examples of seminar topics include "Making Relativistic Games", "An Investigation of the Research Capacity of Osaka University", "The Psychology of Perception" and "The Art of Questioning".

The freshman seminars expose students to a wide range of topics and the functions of a university. Most seminars are conducted in groups of less than 10 students, where their individual characteristics are clearly recognised by their teachers and classmates. The small group



Figure 2. Basic seminars for freshmen—“The art of critical thinking”—an example

setting provides students with opportunities for discussion and participation which are not possible in large lecture halls.

“Thursday Projects” for Science Freshmen, is a compulsory one-year programme offered by the School of Science in which students attend either one of their own majors every Thursday afternoon for 90 minutes. Each seminar consists of five to ten freshmen or a total of 260 freshmen. The seminar topics include “Simple and Deep Mechanics”, “Measurement of Environmental Radiation”, “Challenging Experiments in Electromagnetism” (physics), “Live Imaging of Intracellular Organelles”, “Separation of Photosynthetic Chromophores”, “Experiments on Protein Conformation” (biology) and “The Joy of Mathematics” (mathematics).

At the end of the freshman seminars in the physics department, every student gives a presentation. The teachers are generally not too concerned with the level of achievement as the seminars aim to give first-year students a chance to experience the depths of science. They also refresh students’ memory on basic science concepts to prepare them for the general topics in the first year curriculum. More importantly, the seminars aim to change students’ perceptions of learning which are often influenced by high school learning and rote learning for the entrance examination.

Student-centred education in a globalised world is like environmentalism for education. In freshman seminars, the small classes foster a sense of individuality in each student. Individuality can lead to students’ active participation in university life, classes, research and everything else. Meaningful learning occurs when the following three components work together in the classroom: cognitive domain function (knowledge/comprehension), affective domain function (feelings/motivation), and psychomotor

domain function (manual/physical skills). Large classes tend to be driven by teachers with an obsession to deliver numerous facts and stimulate only the cognitive function in students, resulting in a superficial understanding of the facts.

David Williams, a junior at UC Berkeley who studied mostly in large classes and spent little time in student labs, is now able to experience small classes/student labs at Osaka University, says:

Most importantly, I have learned that it is not my ability to understand a concept to the deepest possible and most complex degree that will allow me to discover facts others have never known, but it is my ability to use this to make simple, concise, and elegant experiments that point clearly to the truth of the matter at hand.

David adds that his experience at Osaka University led to the realisation that in order to become a researcher, he had to understand textbook knowledge “to the deepest,” and his conclusion, before experiencing small classrooms/groups at the School of Science was that “I do not have an ability to become a researcher.” He continues to say that the benefits of small classes are enormous:

Large classes make students feel that they are surrounded by competitors for better grades, and so they concentrate only on PowerPoint slides on a large screen to be memorised, take notes for exams, and pay less attention to the professor. In large classes, professors often present overly general topics in a standard lecture style with a TV-eye, and they avoid expressing their personal feelings and experiences. Small classes help students focus on the professors and they do not feel bothered by their competing classmates. Small classes also make professors change their presentation style, and as they talk to the students, they have more chances to share their personal experiences in research. As a result, small classes give students synergistic benefits, enable them to feel closer to researcher and explore the depth of the information with fresh perspectives, hence resulting in a complete change of mindset towards learning.

Finally, I would like to address the importance of small classes and the role of universities in nurturing researchers of the next generation. The high ratio of faculty members to first-year students (218 to 260), is an inevitable requirement of such a programme and its development cannot always be guaranteed in a research-centred university. Moreover, not all the six programmes (in Figure 1) have secured the minimum number of teaching staff required to run them. As a result, the classes are sometimes taught by volunteer teachers.

The only negative issue is the cost/performance ratio. Although small classes are costly and demand a high student/teacher ratio, their impact on the university at the global scale is beyond question. While an effective reform that would yield benefits for our future is often found in small-sized education, I have yet to know the perfect solution and I would rather share the challenging question with you all. The answer obviously depends on your vision of the world and how you see science. ■

Teaching Sustainable Development to Freshmen

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We live in a world in which almost every literate person has heard of the term ‘sustainable development’ (SD). Most people might also claim that they understand what it means. A simple Google search of the term indicates that SD is featured on approximately 22,000,000 web pages. However, it remains one of the most misunderstood or ill-defined concepts. For example, some bureaucrats might argue that ‘sustainability’ or SD is an empty concept, too vague or ill-defined to be of any use in practical decision-making and real life policy implementation (Jacobs, 1999). The environmentalists might argue that the notion of ‘sustainable use’ of resources is a dangerous influence that is a threat to natural resources worldwide (Patterson, 1998). According to Hattingh and Attfield (2002), instead of contributing towards the protection of nature and ensuring a continued availability of resources, some claim that ‘sustainable use’ is nothing but a green mask used by industry and governments to justify and continue the ruthless exploitation of natural resources as it has always been done before.

In addition to the theoretical misunderstandings, SD means different things to different people. For example, for a poor man living in the slums, SD might mean eradication of poverty and improvement of his life. For a group of people

living amidst a civil war, without a place to call home, SD might mean lasting peace. For a country whose natural resources is rapidly diminishing, SD might mean conservation. For academics who conduct research on SD or policy makers, SD might mean all of these.

In such circumstances, one of the biggest challenges in teaching a vague, ill-defined, misunderstood, yet popular concept is getting the learners to overcome their preconceived notions and learn to understand and appreciate the concept from diverse angles. Socrates (470399 B.C.) said, “I cannot teach anybody anything, I can only make them think.” Although, this statement may not find favour with some, it does make an important point—making the learner think is extremely important. We are firm believers of making students think. If students are not trained to think, use their analytical skills and understand the concepts and their applications, then students may not benefit from attending a module that teaches SD, although they might be able to pass an exam just by memorising certain concepts.

In our view, there are two key aspects to teaching freshmen. The first is to help them transit from rote-learning in pre-university education to a different learning style in the university. The

second is to inspire students to study with initiative and actively demonstrate to them that research- and group-based learning can be effective. With these in mind, we designed a module called “Policies for Developing Sustainable Cities” to facilitate informal discussion-based teaching to a small class. The aim was to cultivate in students the skills necessary for understanding and engaging in research and analysis of issues fundamental to human development by making learning fun. Students not only learn from the facilitators but also from each other, as well as various other sources of information.

The module examined the development of policy initiatives for building sustainable cities. We aimed to help students understand challenges at the national and international levels in building sustainable cities amid growing concerns such as climate change, energy crisis, desertification and economic instability. The main topics included the concepts of SD and sustainable cities, national and international policy framework for building sustainable cities, key challenges to SD, promoting a green environment, and risk mitigation measures and adaptation initiatives.

16 students from the Departments of Architecture and Building read this course. We noticed that those who signed up for the module had a genuine interest in the concepts relating to sustainability. Some have had exposure to practical issues relating to environmental protection and sustainable development through activities they have undertaken as members of NGOs or student societies. This made it easier for us to engage them in discussions and moot-based teaching. The seminar sessions were structured in a way that encouraged students to participate actively in class discussions. Students were required to read assigned readings before each session, prepare presentations and raise issues for further discussion in consultation with the lecturers. Carefully chosen reading materials also gave their confidence a boost and helped them speak their minds in class.

We encountered a number of challenges in the process. Most significantly, that of striking a delicate balance between imparting background knowledge in the form of lectures and engaging students in meaningful discussions moderated by the theoretical rigour of SD concepts. We figured that more instructional lectures were necessary

at the beginning of the course, and the time for students to share their views and opinions on key questions highlighted in weekly readings should gradually increase towards the end of the course. This allowed students to get used to our instructional style and familiarise themselves with the more open and argumentative class dynamics. Furthermore, engaging students to tackle open-ended problems in which a solution can in fact become a problem when viewed from another perspective, made many a little uneasy with not being able to get straightforward and absolute answers to sustainability problems. As the course came to an end, we were relieved to see more students grasping the core nature of sustainability problems and learning to appreciate their complex nature. Such an appreciation of the subject is best inculcated in an amicable learning environment where students are encouraged to become the ‘co-creators’ of the course materials and fellow stakeholders in the sustainability debate.

Another challenge was that several students were unable to finish their weekly reading assignments. We stressed in class that these reading assignments were not an end in themselves; they were meant to inspire meaningful and informed debates by opening students’ minds to new concepts with which they are expected to be familiar. We did not want students to debate on the issues based on their background knowledge without first reading the assignments as this may cause whatever biases they have to grow stronger. In fact, the contents of the assignments were specially chosen to challenge certain popular knowledge or widespread incorrect assumptions on sustainability (e.g. green buildings synonymously mean sustainable built environment).

Although students proposed to have fewer readings, we found that they can cover even more materials when they read up for their class projects! This may imply that some of the reading assignments were too difficult. In future, instead of assigning the five articles to students, we can assign only the two most important ones and then require student to look for three more articles related to the first two using a list of keywords to aid in their literature review. This will also help develop their research skills in addressing and appreciating sustainability problems—a fundamental quality of an academic researcher.

In conclusion, the very nature of SD warrants a seminar- and discussion-based approach to education. As sustainability problems are often multi-faceted, students from a wide range of backgrounds and interests can easily participate in its discourse. We have learnt valuable lessons that will help us improve the course in future. More importantly, as we are also practitioners in SD policies and law, this seminar provides an effective platform to learn more about engaging a wide ranging, non-specialised audience in the multi-faceted and highly complex nature of sustainability discourse.

References

- Hattingh, J. & Attfield, R. (2002). Ecological sustainability in a developing country such as South Africa? A Philosophical and Ethical Inquiry. *The International Journal of Human Rights*, 6(2), 65–92.
- Jacobs, M. (1999). Sustainable development as a contested concept. In *Fairness and Futurity: Essays on Environmental Sustainability and Social Justice*, Andrew, D. (ed.), pp. 21–45. Oxford: Oxford University Press.
- Patterson, G. (1998). *Dying to be free: The canned lion scandal and the case for ending trophy hunting in Africa*. London: Viking. ■

A Freshman Seminar in FASS: “Representing War”

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The FASS freshman seminar, “Representing War,” had two main objectives and two peculiarities. The objectives were for the students to learn to ask good academic questions and for them to take charge of the module as much as possible. The peculiarities were that the module had a tiny enrolment of six, and that it was taught by two people, both of whom were present at every class. The small enrolment caused us to think hard at the beginning of the semester about whether or not to continue in that way. We decided to go ahead because of the module’s experimental nature.

Asking questions

We tried to make explicit from the start the first objective of encouraging disciplined questioning. The IVLE schedule began with the module’s overarching questions, and each section included sub-questions. We reinforced this by emphasising in class the centrality of questions in academic study.

Even so, the message did not get home in the first half of the semester. The aim was for students to ask about how war, warriors and victims are represented, and about what kind of assumptions about war underlie different representations. Instead, they tended to describe the poem, song, movie or play they were dealing with, and sometimes, to forget that it was a representation. So, they moved straight from the text to talking about war itself.

By the middle of the semester, we felt we were failing, and we tried to turn things round with two kinds of intervention. Firstly, we focused in two classes on academic questions, showing with specific examples how they can be formulated, framed and answered. The examples came from our own experience. Secondly, there were individual conferences preparing students for the final assignment timetabled for the end of the semester. We devoted a good portion of these to pushing students to articulate and improve the question behind their assignment.

The final assignments were good, and most of them pursued a valid and well defined question. One considered the war novel, *Catch 22*, for instance, in which the central character, Yossarian is represented as a hero who will do almost anything to avoid fighting. This student asked what kind of hero Yossarian is, and answered with a finely modulated and wide-ranging account of different kinds of heroism. Another paper examined how three characters in the *Romance of the Three Kingdoms* realised, or failed to realise, a warrior code we would analyse in the *Iliad*, while yet another parsed an exchange from the film *Dr Strangelove*. We were pleased with the vigour, and variety, of the questions students had developed.

We wondered about two things as we reflected on this element of the seminar:

- First, was it our interventions which changed students' perceptions, or would they have got there anyway? The answer is probably the usual one in teaching—a bit of both.
- Second, should we have intervened earlier? We reached a point that was almost a crisis halfway through the semester. The students were not developing the central skill we wanted, and we felt we had gone wrong somewhere. Could that have been avoided?

This question is more difficult than the first, but probably, the timing was about right. When we discussed questioning in the abstract at the beginning of the semester, the students missed the point simply because there was no point for them. They were just beginning to become familiar with the materials, and their energies were properly concentrated on that task. It was only once they had read and watched and heard a number of different representations that they could begin to understand why questions were needed and what form they might take. In other words, the crisis was probably inevitable; it probably even helped.

Students taking charge

Freshman seminars give students a chance to take charge of a module while they find their way at the university. We think a dawning sense of *group* endeavour helped students take charge

with a feeling of intellectual adventure. We think, moreover, it was vital for each student to realise he or she had information, interests, perspectives and life experiences which others did not—with those others including their instructors. Once that was recognised, students had plentiful and apt suggestions for materials we might study and shouldered the responsibility well.

Key we think to this was care, at the start, to open the door wide to students' input but to set limits, too. The most important limit was that we chose a definition of war and stuck to it. This stricture was simple but focusing. An early discussion of its merits gave students a chance to practice taking a stand, and replying to dissenting views. This discussion also justified the texts around which we structured the seminar (one epic, one play and one novel). Recognition that texts had not been selected randomly, or for a trivial reason, helped students explain how they chose materials for later discussions, presentations and papers.

Due to the size of our group, we were able to host four lots of presentations. We made the first an ungraded trial run and emphasised the importance of Q&A. We expected stumbles, nerves, laughter, and saw all three. But we saw this too: once students started reflecting, in ungraded writing, on their presentations, they asked us to revise the syllabus to provide more presentation opportunities. Talk about taking charge of the module! Over the course of the term, students found representations of war in a death metal video and a folksy pop song, assorted films old and new, Shakespeare, WWI recruitment posters, an NS marching chant, "The Charge of the Light Brigade," historical accounts in comparison to pictorial images of the face-off at Agincourt, a Chinese television serial—and more. The instructors supplemented this variety with a bit of their own. But we made sure when, for instance, we discussed photographs of the Vietnam War or a few episodes of "Blackadder" that students did most of the selecting and initiated the analyses.

Conclusion

The seminar's success owes a great deal to the students who thought they would give this educational initiative a try. We learnt later that

some of our students' friends wished they had been as daring. Evaluations were positive about our ability to create an encouraging and open environment, and to set limits yet provide freedom and multiple opportunities for students to lead

the class. One suggestion for improvement was nonetheless to give students even more teaching responsibilities. That is a good suggestion we may be able to implement next time. ■

At Last, Learning Can *Really* be Fun!

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As new entrants to the university, freshmen have high expectations about the opportunities to learn in a scholarly atmosphere which is different from what they had in their previous education. Alongside, they also nurture some apprehensions about their own ability to cope with the style and pace of teaching at the university. Those who teach freshman courses have, therefore, a responsibility to make these students feel at home in the university set-up and get them to think and solve problems on their own. The Freshman Seminar (FS) course initiated by the Faculty of Science at NUS is a unique approach to accomplish this goal. I have had the privilege of being involved in teaching the FS course offered by the Department of Biological Sciences (DBS) over the past three years. This paper comments on the course make-up, its outcome and suggestions for future offerings.

Course make-up

With a view to induce a sense of curiosity and adventure, the topic selected for the FS course in DBS was "From form to function: The amazing world of proteins". The theme was dictated by the extraordinarily important roles that proteins play in the living system and by my own involvement in protein research for over 35 years. The course focussed on the intricate three-dimensional structures which govern the function of proteins in health and disease

conditions. After an introduction to these aspects of proteins in the first lecture, students were divided into 3-member teams and assigned topics for their oral presentations in the subsequent weeks with instructions on how to gather data and present their findings. Each team presented two seminars—the first dealt with the folding of proteins into their unique 3-D structures and the second focussed on the role of misfolded proteins in diseases such as Alzheimer's, AIDS, cancer and cystic fibrosis. During the presentations, students raised questions to clarify the presented facts and discussed the implications of the findings. The audience also assessed the performance of the presenting group in constructive ways. Subsequently, students posted their comments on the technical and academic aspects of the presentations in the IVLE forum set up for this purpose. The audience were given written assignments on different classes of proteins and their structure-function relationships. This helped them develop critical analysis and writing skills.

Additionally, in-class guest lectures were arranged to expose students to current research efforts on proteins, with special emphasis on experimental techniques. These were supplemented by tours

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to some of the major facilities in DBS such as the Proteomics Laboratory and the Electron Microscopy facility which house state-of-the-art tools for protein research, such as high-performance chromatography instruments, protein sequencers, mass spectrophotometers and high-resolution electron microscopes.

The freshmen seminar experience

Based on student feedback over the past three years, the FS course has been a great success. Among the several reasons for this success are:

- the small class size,
- the informal teaching and learning methods and
- the lack of rigidity of tests and examinations.

While these are distinguishing features of the FS course, its most important characteristic is the manner in which it shows students that learning can be fun if they seek knowledge out of their own curiosity and apply the right learning techniques to acquire this knowledge. The onus of making it fun to acquire and analyse chunks of knowledge in a relatively short time, and to present it orally and in writing lies with the facilitator. He/she needs to find innovative ways to demonstrate the benefits of critical thinking, self-learning, teamwork, problem-solving, oral and written communication skills, and so on.

The course's emphasis was not so much on getting students to accumulate facts on proteins and their functions as it was on the mode of their acquiring this knowledge through critical thinking. The nature and importance of critical thinking, highlighted in the first meeting, helped students in preparing their presentations, which required them to set up a logical scientific query and gather information to answer it. Built around this main activity was also a variety of learning and presentation techniques such as how to work in a team, conduct literature search, critically evaluate published data, organise ideas for presentation, prepare slide shows with clarity, develop oral and written presentation skills, answer questions from the audience, complete assignments and exchange comments via the

IVLE. The quality of students' presentations was uniformly high and on par with those taking upper level undergraduate exercises.

In these activities, my role as the facilitator was to pique students' curiosity to explore. The small classes allowed an intimacy between the students and me and they regarded me more as their friend rather a 'teacher' in the formal sense of the word. Making students raise questions and solve problems was therefore a lot easier in the FS course than in many formal courses. Students soon learnt that they can accomplish a lot more this way than by cramming facts and reproducing them in an examination, and they started participating actively in seminar presentations and discussion sessions. Through these exercises, students learnt that learning can indeed be fun.

An important component of this course was the continuous feedback between me and the students. Students were constantly encouraged to comment on what could be done to make the course more effective and useful to all. Meeting students outside the class, in my office or elsewhere and asking for their thoughts on the course also helped in this regard. In addition, questionnaires were handed out mid-course asking students for their comments on the conduct of the course and suggestions to improve the performance of both students and the facilitator. This helped me to modify the course on-the-fly based on the class' consensus. The guest lectures and lab tours were particularly welcomed by students. The invited speakers instilled a sense of awe in the students by evincing their passion for research and describing the experimental techniques they used to solve a given problem. During the lab tour, students felt privileged to be exposed to the state of the art tools for protein research and hear detailed accounts of their performance and use in health research.

Future directions

The freedom to conduct independent scientific exploration in an informal setting is the essence of the FS experience. This allows students to realise their full learning potential which is generally not the case in other courses. A similar but not identical approach is used in some of

the courses at McMaster University where I currently teach and conduct my research. Based on my experience at NUS, I would like to suggest that the FS course be made available to more students by recruiting more faculty members to offer several FS courses in parallel. Since the goal of the course is to make students relish the pursuit of knowledge as an exciting exercise, it is obvious that only faculty members with a flair and passion to teach and motivate students should be invited to participate in these FS courses. Once students at large begin to appreciate the merits of the FS approach, there may be a demand to incorporate a similar self-motivated exercise as one of the components of other formal courses.

In conclusion, the FS courses demonstrated that teaching and learning need not necessarily be two different things. On the one hand, the students learnt mostly by their own efforts; on the other, they were given opportunities to 'teach' by sharing with others what they had learnt. As well, the facilitator also learnt new things from students' presentations and discussions. In conjunction with the informal setting of the class, these courses show an effective, novel way for students to acquire knowledge in an enjoyable fashion. On my part, I thoroughly enjoyed teaching the course in DBS and would cherish this experience as one of the highlights of my teaching career. ■



The Centre for Development of Teaching and Learning (CDTL) engages in a wide range of activities to promote good teaching and learning at the National University of Singapore, including professional development, teaching and learning support, research on educational issues, and instructional design and development.

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