CDTLink

NUS National University of Singapore

Centre for Development of Teaching and Learning March 2005 Vol. 9 No. 1

# Facilitating Good Teaching at the Faculty of Science

**Associate Professor Andrew Wee** and **Ms Angela Lee**
Faculty of Science

*A/P Tan Eng Chye kicking off the Teaching Workshop, 27 July 2004.*

NUS today invests a lot of time and effort in teaching evaluations through peer and student feedback and teaching portfolios. Excellent teachers are recognised as role models for the rest of the faculty to emulate. The Faculty of Science helps average or under-performing teachers improve through evaluation and training provided by a Department Teaching Evaluation Committee (DTEC).

An annual teaching workshop is also organised at the start of each academic year to promote good teaching and learning practices among teaching staff from different science disciplines. This year's teaching workshop was held on 27 July 2004 and attended by over 200 faculty members, TAs, graduate tutors and senior graduate students. The workshop comprised invited talks and discipline-specific breakout sessions. The Dean of Science, Associate Professor Tan Eng Chye, kicked off the workshop by sharing his thoughts on curriculum issues, opportunities for effective engagement, assessment culture and the mindset of teachers and students in the learning environment.

## Summary of invited talks

In his plenary talk 'Scientific Knowledge and Scientific Inquiry', Professor Mohanan conveyed the need to develop not only the capacity to engage in scientific inquiry but also to cultivate attitudes towards knowledge that are characteristic of scientific inquiry. He presented a way of accomplishing this goal and how to re-think the entire spectrum of teaching and learning in science from decisions on the curriculum to classroom instruction and the design of learning and assessment tasks.

Professor Andy Hor inspired the audience with his talk 'Research Aggressive = Research Active + Teaching Active' in which he debunked the narrow view based on the principle of 'zero-sum' (i.e. efforts put in teaching are at the expense of research). He highlighted the challenge faced by all academics: how to use ideas derived from their teaching to add value to their research, and how to best utilise their research strengths to improve the quality of their teaching. He pointed out that those with the courage and wisdom to manage such a challenge usually emerge as winners, whereas those who subscribe to the zero-sum doctrine usually fall behind. A case study was also presented to showcase the process of developing an idea from classroom to research laboratory

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inside

to eventually produce a top-class research paper. He also discussed how research ideas can be harnessed to add an important dimension to one's teaching.

Associate Professor Goh Say Song suggested strategies for teaching mathematics to large classes (e.g. teaching and learning through examples, progressive and multiple-level understanding of concepts, use of analogies and appropriate IT tools). He highlighted the approaches for further learning through additional readings, discussions and extra problem sets as well as the practical aspects such as generating and sustaining students' interest. The methodical way in which he delivered his talk provided a live and entertaining demonstration of how a large mathematics class should be taught.

Professor Alex Ip expounded on the importance of project learning (e.g. SEP, SROP, UROPS). Through project work, students learn to deal with controversies, identify and solve problems, create new ideas and make decisions. Through encounters with more challenging questions, students develop intelligent behaviour and acquire affective qualities (e.g. curiosity, openness, reality orientation, objectivity, precision, confidence, responsibility, consensus and collaboration). He stressed the importance for students to not only have a positive 'I can' attitude, but also the passionate 'I enjoy' feeling. From his enthusiastic talk, it was clear that he practised what he preached.

Finally, in his talk 'Lectures Alive!', Associate Professor Edward Teo demonstrated how lectures can be made alive by using IT, live demonstrations and quizzes. He also explained how he used his favourite Star Wars model spacecraft to explain Special Relativity to GEM students. Black hole physics never sounded so simple before! Judging from the positive feedback (Figure 1), the audience benefitted from the morning's invited talks.

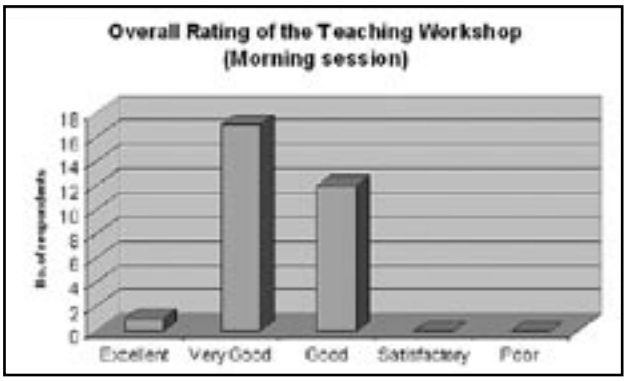


*Figure 1. Feedback for the Invited Lectures.*

## Breakout sessions

Participants could choose to attend any of the three discipline-specific breakout sessions in the afternoon (Biological, Chemical and Pharmaceutical Sciences, Physical Sciences or Mathematical and Statistical Sciences) during which experienced teachers shared pointers on various topics (e.g. communication and engaging students, use of IVLE, common mistakes in the use of slides and multimedia, conducting tutorials and laboratory demonstrations and setting examination papers). Through panel discussions, some TAs and new teaching staff also discussed the problems and difficulties faced in teaching for the first time. Feedback from participants indicated that the breakout sessions were useful (Figure 2).


*Figure 2. Feedback for the Discipline-specific Workshops.*

## Feedback on the teaching workshop

The detailed feedback received for the teaching workshop indicated that it was generally well received. Some specific comments received were:

- "All talks were very interesting, useful and inspiring. They helped me understand and take note of a lot of interesting points that I have failed to notice."
- "Picked up some ideas I can use in future modules and lectures."
- "Some of the slides are very useful for us."
- "Overall, I think the sessions are well presented and are a great learning experience for participants."
- "In my opinion, training teachers is one of the essentials in education."

There were also suggestions put forth for the next Teaching Workshop:

- "More discussions of particular teaching problems and their solutions."
- "How to implement a suggestion like 'pace the course to balance your advanced and worse-prepared student' in a particular course."
- "A dialogue session to address what can be done to improve teaching in the Faculty."

## Conclusion

In organising this workshop, we had little difficulty in finding good teachers who were enthusiastic in sharing their knowledge and experience. The participants showed much interest and excitement, and made an effort to attend and learn from the speakers and fellow participants. The participants' feedback confirmed our view that such teaching workshops should be conducted annually. ■

# Your 15 Minutes of 'Fame'—Maximising the Effectiveness of Lectures*

**Associate Professor Alice Christudason**
Department of Real Estate
Associate Director, CDTL

## The problem

It has been said that "even with a particularly entertaining professor, most students only pay attention for about 15 minutes at a time."[1] This can be a disturbing statistic for those who are seriously involved and interested in teaching and labour for hours preparing for a lecture. This provoked me to think of ways in which the statistic could be defied. However, I realised that it was important for me as a teacher, to understand *why* most students have merely a 15-minute attention span. In this regard, it is useful to first consider the nature of learning.[2]

## The nature of learning

The three main categories of learning theory have been identified as behaviourism, cognitivism and the social construction of knowledge. Each of these is briefly considered below:

- *Behaviourism* is based on the idea that certain behavioural responses become associated in a mechanistic and invariant way with specific stimuli. In other words, a certain stimulus *will* evoke a particular response.[3]
- *Cognitivism* is based on the premise that to better understand learning, in addition to observable behaviour (behaviourism), it is necessary to consider a learner's mental ability to reorganise his psychological field (e.g. his world of concepts, memories) in response to experience.[4] In other words, while behaviourism focuses on the external environmental structures that lead to reinforcement of behaviour, this theory focuses on the mental processes or conscious thoughts on the part of the learner.
- *Social construction of knowledge* recognises the importance of assisting students to develop a critical awareness of the values and ideologies that shape the form of received knowledge. It sees learning as essentially a *social* process, requiring communication among learner, teacher and others. This involves engaging in personal reflection, to seeking new information and testing ideas through social contact with others.[5]

Bearing the above in mind, I tried to devise ways in which the painful statistic could at least be challenged, if not defied. It is not possible to pinpoint exactly *which* theory each measure addressed (as they sometimes overlapped) but the cumulative effect of the steps I took were indeed helpful to keep students engaged in lectures—beyond 15 minutes. Here is a summary of what I found useful:

- Ask questions, give pop quizzes—students *are* motivated by grades[6] (or what you think of their academic ability); but do keep these questions simple and focused;
- Allocate a few minutes for students to vocally *share* their answers to questions or situations you pose; highlight to them a related event that is currently receiving media attention;
- Ask students to consider briefly the advantages and disadvantages or strengths and weaknesses of a procedure or theory[7] if the questions you pose require a prior understanding of fats or data, as a logical progression. This naturally induces a certain level of engagement and builds on the strengths of the social construction of knowledge theory.

## Points to bear in mind:

You may have to vary or combine the above depending on the nature, objectives and demands of your subject (including the level of the Module) as well as the characteristics of your students. The latter includes their age, academic backgrounds and abilities.

Class size and class duration are also critical factors. Thus a one-hour class comprising more than 200 students may be less amenable to a variety of methods than a two-hour class comprising 50 students. Otherwise, there is the risk of ensuing confusion and this will obviously interfere with learning.

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# Web Projects for Teaching

**Assistant Professor Heng Jiuan**
Department of Philosophy

Web projects help liberate students from the shackles of ingrained habits. When students have been trained to reproduce a certain 'form', 'structure' and 'style' in their work, the apparent formlessness of the Web may come as a shock to them. They panic and resent these projects. This is always the case, no matter how detailed the brief, or how much support is offered by way of comment and consultation time, scrutinising and commenting on project outlines and drafts. I have found that assurance works best—students need to know that if they put in the effort, the walk on the wild side will still yield them their desired results.

The greatest challenge, however, is that students have to work in groups to complete a reasonably good Web project. The lack of coordination shows up in a way that is more difficult to detect in written reports. Students discover for themselves the possibilities of group synergies and dynamics as well as the power of true brainstorming. When the project is successful, it inspires students to believe that they have more to contribute to the group.

When it fails, students are disappointed and may even feel that the teacher has jeopardised their futures. In these instances, I stand firm and point them to the best examples of group work that demonstrate how the whole is more than the sum of its parts. I remind them that they have been warned about the snares of group dynamics and how they must confront these problems as they arise, or suffer the consequences in their final grade. I then suggest that perhaps there was something he or she could have done differently and commiserate.

Group chemistry is elusive and it is unfair that a part of students' grades should be based on something outside their control. But this is what life is. Team work assumes that the individual is not the only unit of assessment and grading must not only reflect that but it must also take into account the vagaries of group chemistry.

Most of my students will not become philosophers but they will have to come to terms with team work, throw themselves into group processes and communicate their vision in various media (e.g. conversation, writing and multimedia presentations). Web projects offer students a gentle introduction to the rough and tumble of working life and a chance to bid farewell to the boundaries of their childhood.

Because of their nature, Web projects are also equalisers because academic disciplines are founded on linear thinking and students whose intellectual personalities are non-linear often cannot exhibit their best qualities in the conventional modes of assessment. The most powerful, if daunting and controversial, argument for introducing Web projects is that they call for non-linear thinking. I believe that much of day-to-day life has to be lived in non-linear fashion and that rigour comes only after the raw and messy business of making connections creatively.

Sadly, I am rethinking the wisdom of Web projects today. When I first started introducing them, group projects were a novelty—students had just that little bit more time to explore. Today, the average Arts student takes five modules per semester and is often too stretched for time. Most have difficulty keeping up with readings and are dissuaded from enrolling for the module because they dread group projects.

The piecemeal solution is to tailor the evaluation process to reflect these contingencies of the academic culture. But the real question is whether the curriculum leaves room for creative thinking. Maybe creativity can be nurtured with a dose of unstructured time. ■

# The Hidden Tutorial: Helping Students Prepare for Group Presentations

**Senior Lecturer Stephen Keck**
Department of History

One main feature of undergraduate education is the interaction between students and their teachers. Normally, this is understood to occur within some accepted modalities: students meet their teachers in lectures, tutorials and, in some unique cases, individual supervision. Yet, there are other significant areas for student-teacher interaction: a case can be made that some of the best and most neglected areas of teaching occur when faculty members provide students with guidance for projects and group presentations. My experience in teaching NUS undergraduates has taught me that one of the best ways to instruct students is to get them to work on a project. Requiring students to sink their energies into a project also means that they will come and meet with me for directions. It is this meeting—the Hidden Tutorial—that is the subject of this article.

At NUS, group projects have been emphasised for many reasons. It not only provides students with the experience of working together but also offers more space for creativity (i.e. 'think outside the box'). Furthermore, group work also gives students more opportunities to capitalise on their multimedia skills.

Like many of my colleagues, I worry about the composition of student groups and their capacity to deliver a final product. Normally, I will try to find out as much as I can about the students by getting them to write on the first day of class and then creating groups that are as diverse as possible. I will make sure that the groups are balanced with both good and weak students. While these concerns are important, the *process* by which a group works is equally pertinent as it creates new teaching opportunities.

As I have made group presentations mandatory in my modules, I am accustomed to visits from student groups seeking instruction for their projects. I realise that these visits are perfect opportunities to actively engage students in learning. Students tend to pay more attention during these meetings because there are real stakes (e.g. self-interest) involved in their presentations. They are also more open to suggestions and more eager to learn because they are able to use the information practically.

In the best instances, students will come as groups and are prepared for a rigorous and wide-ranging discussion. The next 30 or 40 minutes will then be a special, but undesignated tutorial. Most students will have read up on the topic while many will have formed a definite approach to the project. The discussion, then, can be lively as students consider different approaches or weigh the pros and cons of each approach among one another. Getting them to talk about the different ways in which they will present the material, for example, can lead students to think about the course in new ways.

As a result, I restructured my classes to exploit the advantages of the hidden tutorial. All presentation groups are to meet with me twice during the course, the first of which will explore the chosen topic together. Students are then told to prepare an outline for the second meeting which should describe their approach to the presentation that usually involves a discussion about the nature of the material and how it augments the course's main themes. In order to facilitate these goals, I *require* students to bring their outlines to the second meeting. Since these sessions revolve around their outlines, they can actually resemble Oxbridge tutorials, where students submit essays to their tutors. I will often fire questions at them to see how well they really understand the material in the outline. My supposition is that many students have become proficient at downloading material from the Internet without always fully comprehending it. Admittedly, these conversations are uneven and student participation within a group is not uniform. Nonetheless, I am convinced that when students leave my office, they not only feel

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more comfortable with their presentation, but are also armed with a more complete understanding of the course dynamics (e.g. its content and themes).

However, it has to be noted that crafting a hidden tutorial has its limitations. The technique probably would be less effective in broad survey or introductory courses. While I have employed it with success at the 2000-, 4000-, 5000- and 6000-levels, these hidden tutorials probably work best with advanced undergraduates and MA students. In addition, hidden tutorials complement multi-layered courses which have been constructed around a combination of themes and methodological reflection. To put it simply, the more basic the course, the less advantage there is in using hidden tutorials.

Here are a number of practical suggestions to note while implementing hidden tutorials:

- Teachers should use student groups (and their projects) as more than a means to divide work load as they offer the potential for additional levels of instruction.
- Teachers should fully utilise student group discussions not only to ensure a successful classroom presentation but also to develop the course's nuances.
- Planning a module with group presentations also means looking ahead to the discussions with students outside class.
- The hidden tutorial works when there are two meetings with student groups; students must bring in an outline for the second discussion.
- These meetings also offer the teacher a chance to see how successful he or she has been in advancing the course's main themes.
- Presentations tend to be richer and more balanced with the inclusion of hidden tutorials. A teacher has the opportunity to make sure that all students participate and that they work well together.
- Better organised presentations ensure that the class does not suffer (as is often the case) when one or more students give substandard performances.
- There is much to learn from students in these tutorials as they uncover new information and sources. More importantly, since these discussions help to generate new ideas, they help the teacher better understand the points of contact between his/her module and other avenues of knowledge. ■

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## But how will you know?

The best method for ascertaining the effectiveness of the steps you are taking to optimise your lecture slot is by obtaining feedback from your students. This may be formal or informal but it is best done *during* (not after) the course. Perhaps you can also request a peer review. These will assist you to fine-tune your approaches and use your better judgment as to what techniques are more effective to defy what the statistic says you have. The key is to introduce *variety* during the lecture and increase interaction. This way, during a 60-minute lecture slot, there will be approximately four 15-minute sessions to make use of!

## Endnotes


1. Wankat, P. & Oreovicz, F. (2003). 'Teaching: Breaking the 15-minute Barrier'. *ASEE Prism* Vol. 12, No. 8 (April 2003). http://www.prism-magazine.org/april03/teaching.cfm. Last accessed: July 16, 2004.
2. Bates, A.W. & Poole, G. (2003). *Effective Teaching with Technology in Higher Education*. Jossey-Bass: John Wiley. See also Donovan, M., Bransford, J. & Pellegrino, J. (Eds.). (1999). *How People Learn: Bridging Research and Practice*. Washington, DC: National Research Council, U.S. Department of Education's Office of Educational Research and Improvement.
3. Wankat, P. & Oreovicz, F. (2003). *op. cit.*
4. Fontana, D. (1981). *Psychology for Teachers*. London: Macmillan/British Psychological Society.
5. *Ibid.*
6. Wankat, P. & Oreovicz, F. (2003). *op. cit.*
7. Fry, H., Ketteridge, S. & Marshall, S. (2003). *A Handbook for Teaching and Learning in Higher Education.* 2nd edition. Kogan Page. ■


* *an adapted version of this paper may also be found in* Ideas on Teaching Volume 3*, pp. 26–27.*

# Making Sense of Learning with Schemas

**Senior Lecturer (Teaching) Lily Chong**
Human Resource Management Unit

On occasions when we encounter a new situation, we attempt to make sense of it by filtering new experiences through prior frames of reference or schemas. A schema is a mental codification of experiences and it is a useful concept to understand how we learn. It comprises a specifically-ordered sequence of cognitive perceptions and responses to a complex situation. As we interact with the world, we develop concepts or schemas about the way we construe or make sense of our experiences. Society's collective understanding, values and norms greatly influence these frames of reference. Examining the learning process from this paradigm provides an opportunity to understand how students learn and practice what they have learned in the classroom and in their everyday lives.

A class activity ('A Case on Conflict Management') in HR 2002 "Understanding Human Relations in the New Economy" specifically illustrates the use of schema to understand how students learn. It investigates an interpersonal conflict between two members working in the same project team beginning with an exploration of students' early schemas of handling interpersonal differences in the case study. When probed, students tend to focus more on their co-worker's disagreeable personal characteristics (e.g. "She is loud, highly competitive and never seems to be considerate of others").

The students embark on the exercise with a simple concept or schema of the case that involves working with a potentially 'difficult' co-worker and a feeling of anxiety. As students discover more details, their simple schema expands and evolves to include other characteristics of their co-workers. For instance, the supervisor appoints a co-worker from the group as team leader. At this point, the exercise provides ample time for students to raise and analyse case details (e.g. how others feel about the team leader), thus encouraging them to engage in cognitive thought (e.g. the rationale for the supervisor's choice of leader and team members' reactions to the appointment).

In this manner, students' schemas continue to expand as they discuss these core concepts with group members. The group-based learning exercise challenges them to analyse their own underlying personal beliefs, attitudes, goals and assumptions, consider alternative responses and acknowledge others' input, thus fostering more elaborate student discussions. Frequently, these group discussions help students arrive at a more realistic appraisal of themselves. In some cases, whilst they admit that they believe themselves to be as competent as their team leaders, and as such, deserve the leadership position, they also realise, for example, that their counterpart is not as 'difficult' as they have originally assumed. More often than not, they would share their frustrations, caused not so much by the choice of the team leader, but rather, by the lack of information or participation in the decision-making process of the leadership appointment.

As the case illustrates, the original simple frames of reference are enlarged, revised, connected, forming more complex schemas of students' learning journeys. Through integrating information and core ideas and sharing meanings through personal experiences, the process of modifying, creating and integrating these schemas creates a complex web of knowledge and beliefs that guides thinking in the particular community of practice among students in the classroom and everyday life.

Subsequently, when students encounter a similar conflict situation in the future, their schemas will expand further. Faced with a new scenario, students project their own cluster of schemas onto the situation, structuring it around what they have learned in previous encounters both in the classroom and everyday settings. The process enables them to relate new information to the old and generate better quality inferences and decisions.

The paradigm of learning in schematic form is both a product and a process. On the one hand, the product is a change in understanding schemas, and in this case, students may realise that the difficulty may in fact lie with themselves rather than their co-workers. On the other hand, the process of learning involves examining, revising and integrating schemas within a particular context of application. For instance, students' earlier encounters, in which a confrontation or cooperative approach proves successful, may justify their handling the situation in a similar way in the future.

We can see that schemas developed within a setting are dependent on the context in which core concepts are learned. Students' evolving schemas on conflict management are both the outcome of their own experiences acquired in a structured classroom setting as well as constructed within the social context of interaction. This in turn generates the foundation for students' learning journeys. ■

TLHE 2004

# Pre-conference Workshops
## 30 November 2004

Two pre-conference workshops focusing on the theme of the conference, 'Individual and Institutional Self-assessment in Higher Education', were held on 30 November 2004 at CDTL. The workshops were chaired by the conference's keynote speaker, Peggy Maki (Former American Association for Higher Education Senior Scholar) and CDTL's Deputy Director, Professor KP Mohanan.

The First International Conference on Teaching and Learning in Higher Education (TLHE) was held on 1–3 December 2004 at the NUS Engineering Auditorium. With over 200 speakers and participants from 19 countries attending the conference, there was a lively exchange of ideas, solutions and experiences. Feedback for the event was very positive and encouraging.

*Conference Keynote speaker, Peggy Maki and CDTL's Associate Director A/Prof Eleanor Wong*

*CDTL's Associate Director A/Prof Whalen-Bridge exchanging ideas with pre-conference participants over tea*

*Conference Chairman Prof Wang Chien Ming mingling with pre-conference participants*

## Oops...

The following names were omitted from the list of Excellent Teacher Award winners in our November 2004 issue:

**Faculty of Arts and Social Sciences:**

Associate Professor Philip Holden

**Faculty of Medicine:**

Associate Professor Bay Boon Huat

Dr Chong Yap Seng

Dr Goh Poh Sun

Professor Gopalakrishnakone P

Associate Professor Hooi Shing Chuan

Associate Professor Shazib Pervaiz ■

## Welcome!

CDTL would like to welcome as Associate Directors:

**Associate Professor Khoo Hoon Eng,**
*Faculty of Medicine*

**Dr Gary Tan,**
*School of Computing*

**Associate Professor Ang Kok Keng,**
*Faculty of Engineering*

## Goodbye!

We would also like to thank:
**Mr Gilles Doiron**, our Principal Education Technologist who left in January 2005 for all his invaluable support in the past and wish him the best for his future endeavours. ■

# The First International Conference on Teaching and Learning in Higher Education 1–3 December 2004

*The Provost, Prof Tan Chorh Chuan, delivering his opening address*

*TLHE participants*

*Keynote Speaker Peggy Maki, Prof Tan Chorh Chuan and Prof Daphne Pan*

*Top: Peggy Maki with Prof Wang Chien Ming*

*Right and Bottom: TLHE participants enjoying themselves at the Singapore Night Safari*

*Right: Invited Speaker Caroline Baillie from Queens University, Canada*

*Bottom: TLHE participants helping themselves to the sumptuous tea break*

# Teaching & Learning HIGHLIGHTS

*School of Design and Environment*

## Teaching Seminar 2004/2005

To kick off the second semester in AY 2004/2005, the Departments of Building and Real Estate held a lunchtime teaching seminar as part of its regular series of talks. The seminar was attended by staff from both departments and for the first time, it was open to Teaching Assistants as well. The speaker was former OEA winner, Associate Professor Bernard Tan, who heads the Department of Information Systems at NUS. The topic of his talk was 'Coping with the Challenges of Rapid Content Changes'.

*Figure 1. The School of Design and Environment's Teaching Seminar 2004/2005.*

As in many technology-related fields, Information Systems (IS) is fast moving, characterised by rapidly changing technologies and practices. This poses special challenges to the IS faculty who have to constantly react and respond to rapid content changes during the course of teaching. Using CS 4251 "Strategic IS Planning" as an illustration, A/P Tan discussed some ways in which he and his colleagues are able to both deal with rapid content changes and at the same time, add value to students' learning experience. The approach emphasises the importance of stable conceptual frameworks to anchor the body of rapidly changing contents and to guide the design of major class assignments. Calling such an approach 'Process-Centric Education', A/P Tan cited the following additional benefits: the updating of course materials through completed assignments and mutual learning for both lecturer and students.

A/P Tan concluded his presentation by providing insights into the implications for staff in terms of time and effort. During the Q & A session that followed, staff queried the mechanics of the implementation of assignments, the judicious handling of the increase in contact time with students and time management in general. Feedback to A/P Tan's presentation was very positive—"enlightening", "refreshing", "candid and confident". More concretely, some staff members indicated that they were going to try out or adapt some of the techniques for student management and assessment to their modules. ■

*Faculty of Engineering*

## Laboratory as a Practical Training Venue

A laboratory setting is a more conducive learning environment than lecture halls (especially for large classes) as it provides students with real life situations and a chance to exercise their problem-solving skills. By reducing the amount of technical materials in handouts/manuals and providing the optimal (but not excessive) number of experiments, we can minimise information overload and regurgitation among students. At the same time, students have more time and opportunities for hands-on experience, active thinking and knowledge reflection. In addition, a teamwork environment encourages students to practise their interpersonal skills as well as to nurture team spirit and leadership. Finally, oral examinations and presentations provide an opportunity for students to sharpen their mental response and presentation skills. Exposing students to the abovementioned elements will make them more equipped when they step into the workforce, whether they are in engineering, research or business. ■

## *Faculty of Science*

### Learning to Experiment...Experimenting to Learn

The journey to provide hands-on learning experience to students of the Department of Chemical and Biomolecular Engineering continues! During the first semester of AY 2004/2005, more than 250 students enrolled in CN 3421 "Process Modeling and Numerical Simulation" were involved in group projects dealing with the design and analysis of experiments.

While most student groups (maximum three members per group) focused on understanding the effect that design variables had on response variables in different activities (e.g. rock climbing, riding a bicycle, concocting sparkling cocktails, rice making, popcorn making, oxidising apples and designing paper fighter aircrafts), other students either completed a computer-based design of experiments and optimisation project or developed a soft sensor using industrial data. Despite the stress of planning and conducting experiments and completing the project in a short time period, students responded admirably to the challenge. Many students indicated that it was a refreshing learning experience. ■

### Virtual Lab Sessions for Math Module

For the second semester in AY 2004/2005, the regular lab sessions for MA 1506 "Mathematics II" are replaced with virtual lab sessions. In the past, Engineering students had to travel to the Science faculty to attend these sessions at the math computer labs at scheduled timeslots. A lot of administrative work is therefore required to coordinate the booking of labs, assigning of lab assistants and marking of lab quizzes.

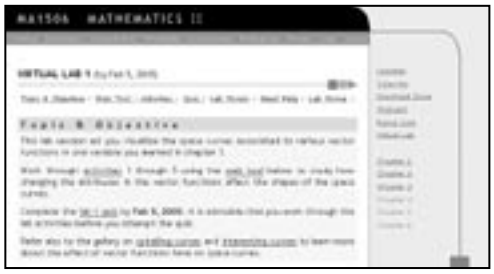

*Figure 1. Screenshot of Virtual Lab in session for MA 1506.*

The new virtual lab allows students to access the lab online anywhere anytime. Each lab comprises two components: lab activities and a lab quiz. In the lab activities, students will use Web tools or applets to explore and visualise concepts taught in lectures. Breeze presentations are also developed to demonstrate how to use the various Web tools. Discussion forums are also set up for students to discuss among themselves as well as to communicate with both the lecturer and lab assistant. The lab quizzes are designed using the IVLE assessment tool and are marked automatically by the computer programme, thereby saving time. ■

## *Faculty of Arts and Social Sciences*

### Personalising Learning in Theoretical Classes

Students often remark that they find it difficult to relate abstract lecture concepts to their everyday life and future career. A new component—a post-lecture question—of IF 2210 "Aesthetics of New Media" aims to bridge together abstract concepts with students' everyday experiences.

To illustrate, after the lecture on 'representation' and the aesthetics of 'realism', students are asked to submit their favourite picture and explain the reason for their selection. Some of these answers (that better relate seeming 'realism' of the picture to a complex set of chosen manipulations) are then read in class. Students are proactive and highly creative in answering the post-lecture question, even though it accounts for only a small portion of their class participation grade. As a result, their understanding of the subject and its relevance to their future careers in creative industries has been improved. ■

*Figure 1. Student Tan Meng Lee considers this photo as 'a successful portrayal of adorable 'her', describing how her aunt used 'props' (a hat, a pretty 'large' umbrella, a make-up) in this picture to 'assist' herself in representing the 'adorable nature of children'.*

# Creating an Inclusive Learning Environment in the Multicultural Higher Education Classroom

**Sheila Trahar**
Lecturer, Graduate School of Education, University of Bristol

International higher education communities are complex places. The challenge of preparing students 'to function in an international and inter-cultural context' (Knight & de Wit, 1995:13) is one which few students and still too few academics seem to have taken seriously (Volet & Ang, 1998). This article will illustrate some ways in which encouraging and inviting cross-cultural teaching and learning dialogues can result in more inclusive learning environments that are productive and enjoyable for all participants.

## Acknowledging diversity

The international postgraduate students that I work with are highly educated, professionally experienced people who may have developed their knowledge in contexts with different academic values from those in the UK and will be working in a language which is not their first. Biggs (2003) urges a move away from focusing on the **differences** between people towards the **similarities** in their experiences. Yet the 'hybrid identities' which Marginson and Mollis (2001:596) claim are assumed by many international students and academic staff resonate closely with my own experience. I am finding that by articulating the **differences** between us, these 'hybrid identities' can then be embedded successfully into learning approaches which focus on exchanging, reshaping and critical appreciation of the range of different knowledges and practices encountered. Such approaches are more inclusive because they emphasise 'the appreciation of cultural diversity and cultural similarities' (Ofori-Dankwa & Lane, 2000:497) rather than indulging in assimilative practice which 'stresses adjustment to the dominant culture' (Ofori-Dankwa & Lane, 2000:498).

## Speaking together

The first few moments of any group gathered together for a specific purpose are crucial in establishing the kind of atmosphere within which the future life of the group can develop and its tasks carried out successfully. Creating an atmosphere of openness where people feel encouraged to set their own learning agendas and to participate in discussion so that they can learn from each other's experiences has always been important to me.

In seeking to establish such quality learning relationships from the outset, I have always planned the first session of my courses to include a range of activities where students are encouraged to move out of their 'comfort zones' to get to know those from different cultural backgrounds. A consistent theme, however, in my personal conversations with some international students has been their struggle with the English language. Some students, who are self-conscious about their spoken English, have told me that they are hesitant about speaking up especially in the early stages of the course. These students find it threatening when they are asked to discuss their responses to unfamiliar concepts in a language that is not their first even though they readily discuss those concepts outside the class in their social groups. I am seeking to respect their acknowledged shyness about their spoken English by facilitating in the early part of the course, discussions of ideas with people with whom the students share a similar first language. Students are also encouraged to form learning groups to discuss the focused readings set between each session. These activities help students to identify together, the appropriate English words and expressions so that they can feel confident to express their ideas in the classroom and to offer opinions on how those ideas impact them in their own context.

Students whose first language is not English also want opportunities to interact with native speakers and thus, it is important to facilitate small group activities where there is a mix of native and non-native speakers so that each can learn from the other. Students feedback that such learning approaches help them develop confidence, lessen their feelings of homesickness (to which many of them are very understandably prone) (Volet & Ang, 1998) and feel included in the learning environment.

## Personal tutorials

One Taiwanese student suggested that speaking and questioning in a larger group would be easier for many of his colleagues if they had first shared their opinions and questions with me in an individual conversation. He encouraged me to see that although I offer tutorials and comments on written work in progress, Taiwanese students find it difficult to put themselves forward. He

suggested that I direct each student to have an individual tutorial with me, as this would help him or her to feel 'very special' and to feel that I cared about him or her: "It would help them to build their basic relationship with you. For Taiwanese people, relationships are important."

Relationships with students are important for me too. But I build these relationships based on the principles of autonomy (i.e. students needing help will take the responsibility to ask). Studies conducted with international postgraduates reflect a similar conflict between students recognising themselves as independent adult learners yet wanting much more guidance from their British tutors than they feel that they are getting:

> One's unspoken demands for more pedagogic control somehow feel infantile, or in bad taste, and one feels vaguely uncomfortable about them but can never discuss them because of the local culture, which is taken for granted and unquestioned. (Wu, 2002:389)

I am now taking more 'pedagogic control' and questioning my 'local culture' of belief in learner autonomy—a belief that can, in turn, lead me to present myself as more of a resource for students rather than a transmitter of knowledge and to resist the authority vested in me as a tutor by many international students, especially those from Confucian heritage cultures (CHC). Actively finding ways to encourage participation from the more reticent students while ensuring that they are not silenced is an important recognition and use of my authority that can lead to all students feeling included rather than excluded.

Both international and home students welcome my efforts to encourage transcultural discursive practices. This indicates that students **do** take the challenges of functioning in an international context seriously. It may be that as tutors, we have an overriding need to assimilate and accommodate rather than to engage in a more critical consideration of our dominant pedagogical practices which can lead to a more genuinely inclusive learning environment.

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# An Integrated Approach to Teaching Chemical Engineering by Interactive Process Visualisation


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## Introduction

The modular approach to teaching chemical engineering often raises an important question: do students understand and appreciate the contributions of these modules in the context of designing and operating a chemical process on an industrial scale? Many

*continued next page.*

chemical engineering curricula around the world have a compulsory capstone plant design project in the final year where students get an opportunity to apply their design knowledge acquired from different modules to complete a comprehensive process/plant design project. Such projects are important in the training of a chemical engineer. Perhaps a strong complementary approach will be to expose the students to the interconnectedness of content knowledge and how the process units interact with each other from an early stage in the curriculum.

We would like to present how interactive process simulation and visualisation software can be used as a common platform to integrate modular teaching. We hypothesise that such an integrated approach will help students to better appreciate the interconnectedness of knowledge acquired in different modules, which in turn will also stimulate their interest in the modules.

## The software

We have created a simple process flowsheet in collaboration with the Centre for Instructional Technology (CIT) that simulates a methanol production process. The flowsheet comprises a reactor, flash separator, distillation column and absorber as main units (Figure 1). It shows the individual and overall mass balances and allows students to study the impact of operating variables on various units in a limited way. Design of different units will be emphasised in different modules and the flowsheet will act as a common storyboard for students to appreciate the connection between various modules and their importance in the context of a chemical process. This tool rides on the capabilities of FLASH—a software platform that enables multimedia content to be built into webpages thereby facilitating an interactive e-learning experience for students. The software may be accessed for academic use at: http://courses.nus.edu.sg/course/chels/integrated/cn.htm.

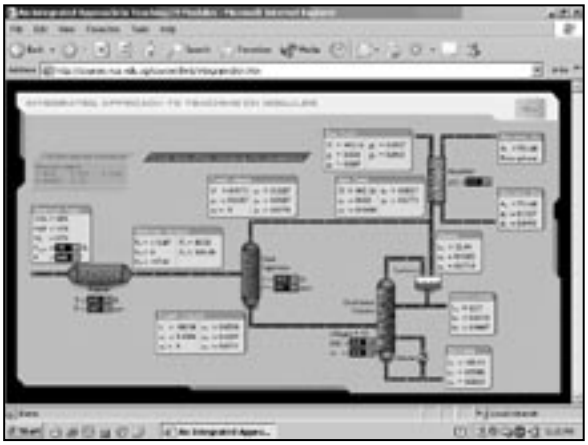

*Figure 1. Screenshot of the interactive visualisation software for a representative chemical process*

As the MATLAB platform overcomes the computational limitations of FLASH, the possibility of using MATLAB as the computational backbone and its GUI development tools for visualisation have also been explored in the form of a final year research project.

## An example of how the tool is used

The tool is currently used in CN 2123 "Equilibrium Stage Separations"—one of the beginning process design modules in chemical and biomolecular engineering curriculum. It serves to show the interaction among the various primary separation process units (i.e. flash, distillation and absorption) which are core learning objectives for the module. Students are asked to use the software to think through a set of questions for further discussion during the first tutorial. Some representative questions are given below.

- Verify if the software achieves mass balance closure for all the components.
- Prepare a short description of the process based on what you see on the screen.
- What is the role of the flash separator?
- Set the reactor temperature to 400 K and pressure to 150 atm. Now observe the effects of changing temperature and pressure of the flash separator. Choose a few temperatures and pressures and note down the corresponding results. Can you draw a general conclusion based on the trends observed?
- How does the change in the pressure or temperature of the flash separator affect the absorber and the distillation column?
- What is the role of the absorber? How is the exit $CO_2$ concentration from the absorber related to the L/G ratio? For the default operating conditions in the reactor, what % of $CO_2$ fed to the absorber is coming from the distillation column?
- Due to changing market conditions, you have been asked to reduce the fraction of methanol in the distillate stream to 0.97. Explore a few ways of achieving this. Start with the default conditions. Do you think all the possibilities you have come up with are equally justifiable in a real plant? Discuss and rank the options in the order of merit.

## Conclusions

The idea of integrated teaching of chemical engineering modules by interactive process visualisation presented here provides a supporting pedagogical approach to actively engage students in the learning process. Though the software presented in this paper has limited capabilities, it allows instructors of different modules to take students beyond the scope of textbook problems, help students explore a wide range of operating conditions and inculcate a deeper understanding of principles of the process. ■

# Global Engineering: Clues from Industry for Education*

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## Background

We are living in a world that is seeing an accelerating trend towards globalised research and development that depends on integration and collaboration. How do we train students to succeed in this new environment? This article highlights some industry trends and best practices in R & D that may offer clues on how we can better prepare students for this new world and make learning more enjoyable for them.

## Global R&D challenges

A dominant issue in industry is reduction of bottlenecks in the development process. In discussions across a breadth of industries ranging from communications to automotive, there are two themes that consistently arise:

- *Converging Complexity*—increasingly unfamiliar technologies are converging to make products more complex. For example, car radio has evolved from a AM/FM tuner to a full automotive telematics subsystem that integrates audio, video, navigation, diagnostics and communications functions into one device (Figure 1).

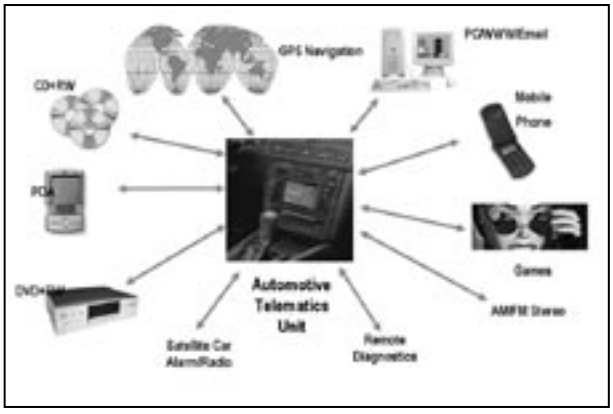


*Figure 1. A full automotive telematics subsystem*

- *Global Design to Manufacturing (GDM)*—the development cycle is no longer confined to one team, one building, or even one country. Today's engineering initiatives often span several teams, companies and culture, so achieving efficient and error-free development across these boundaries raises not just technical issues, but linguistic and behavioural ones as well.

## Industry best practices

Companies are experimenting with many approaches, but the best practices in the development process can be grouped into two broad classes:

1. closed-loop-design methodologies that combine the traditionally separate tasks of design and validation into one integrated cycle;
2. adoption of a common development environment that promotes reuse of knowledge across development processes and teams.

## From Closed-loop-design to Closed-loop-learning

The design iteration cycle can be abstracted into the four iterative steps of modeling, prototyping, testing and analysis (see inner cycle of Figure 2). Solutions to accelerating this cycle start from the following observations:

- modeling is vastly improved with modern computing tools, but effort spent on systems integration and design validation is growing due to increased complexity,
- significant losses in time and quality are caused by switching tools and breaking information flows at each phase of the cycle.

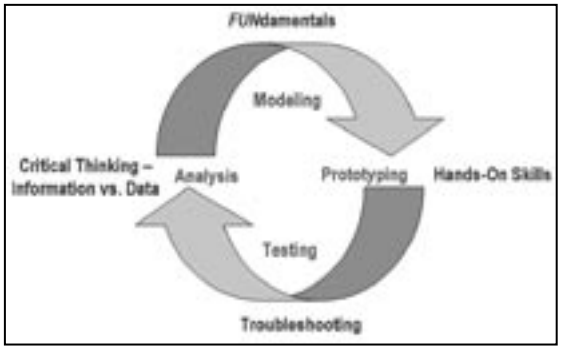


*Figure 2. The design iteration cycle*

These problems can be solved by first adopting tools that integrate with one another. Furthermore, the adoption of these tools needs to allow linked simulation

and test methodologies that will in turn facilitate comparisons of actual to simulated results. Designers should also consider the development of structured design elements that can be reused in later processes.

No matter what tools are used, the success of this integrated process in industry suggests that students will benefit from acquiring their engineering and scientific skills in a similar manner. The four steps of industrial closed-loop-design cycle can be translated into matching elements of an effective closed-loop-learning process (see outer cycle of Figure 2) that is made up of learning the *FUNdamentals*, developing *hands-on skills* by building prototypes and *troubleshooting* the design using *critical thinking* to translate experimental data into meaningful information.

Can engineering and science education adopt these elements instead of using disjointed classroom and laboratory experiences? Can students use closed-loop-learning cycles that integrate a set of fundamentals that emphasises hands-on experience? A common misperception is that this requires significant and costly infrastructure and laborious development of new instructional materials, but my travels indicate that faculty members are doing this successfully with a minimum of materials and a maximum of creativity. For example, the Mindstorms/RoboLab robotics system developed jointly by Lego, Tufts University and National Instruments, is simple and flexible enough to teach university students elements of embedded control while allowing elementary children to have fun building robotic toys (Figure 3).

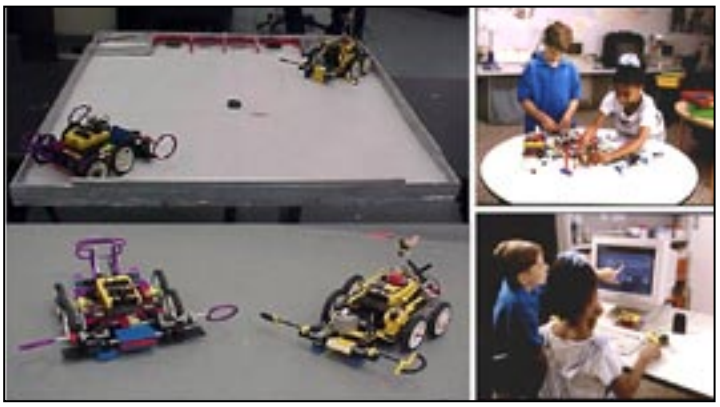

*Figure 3. Robotic toys for elementary children*

Most successful educators find creative ways to insert these methods into an existing curriculum and do not change the entire curriculum. The following are a few elements that educators are using to move students closer to a more integrated and fun learning process:

- use software to animate the theory, but *add* hands-on, experiential learning;
- select a few, common tools so that the focus is on principles and methods;
- offer design exercises to first-year students;
- challenge students with exciting, relevant projects (e.g. building an MP3 music player, exercise heart monitor, rain collection gauge). ■

** the article is based on an invited talk given at the annual conference of the U.S. Engineering Deans Institute in New Orleans in March, 2004.*


CDTL The Centre for Development of Teaching and Learning (CDTL) provides a wide range of services and facilities to promote the teaching, learning and research programmes of the National University of Singapore. These include teaching and learning support, research on educational development issues, as well as instructional design and development.

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