Embedding Graduate Attributes in Assessment Tasks

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What kinds of graduates do universities wish to produce, and how should they go about doing so? Recently, Australian universities have had to grapple seriously with this question in response to the Federal government's decision to tie the funding of each university to their quality of teaching. This note will present the steps taken by my university and department to embed attributes which are considered desirable in our graduates. Although I shall be mainly describing my experience in the discipline of law, the measures taken are readily applicable to other disciplines.

My University's statement on graduate attributes

The starting point of the project was for my university's Executive to decide on a list of graduate attributes. The absence of such a document may come as a surprise to people outside the tertiary education sector but it was, until recently, uncommon for Australian universities to have one. While most universities (including mine) would have 'mission statements', these were invariably cast in broad terms and insufficiently specific in indicating the values and skills which the university sought to produce in their graduates.

My university's Executive instructed the on-campus Centre for Teaching and Learning to produce a draft which was then circulated among the departmental boards for comment. The final version, which was debated and eventually endorsed by the University's Academic Board and the Senate, reads as follows:

The attributes which graduates of Southern Cross University are expected to develop during their programmes of study are:

- *Intellectual rigour*—a commitment to excellence in all scholarly and intellectual activities, including critical judgment.

- *Creativity*—a commitment to achieving imaginative and creative responses to intellectual, professional and social challenges.

- *Ethical understanding* and *a commitment to the highest ethical standards* and *sensitivity* to moral issues and conflicts.

- *Command an area of knowledge* to enable a smooth transition to professional or other scholarly settings.

- *Lifelong learning*—the ability to be responsive to change, to be reflective in practice and to be information literate in order to update one's knowledge through independent and self-directed learning.

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- *Effective communication and social skills*—the ability to communicate and collaborate in ways that are appropriate in scholarly, professional and social settings.
- *Cultural awareness*—a global world view encompassing a cosmopolitan outlook as well as local perspective on social and cultural issues, together with an informed respect for cultural and indigenous identity.

My department's statement on graduate attributes

Following the issuance of the University's statement, each department was required to produce its own discipline-specific statement of the skills and values it wanted to find in its graduates. While each department was to have the University's statement in mind, they were encouraged to produce their own list of graduate attributes. My department, after several meetings and a two-day teaching workshop, decided on the following statement:

The Department of Law aims to achieve its mission by producing graduates who:

- Are gender, culturally, socially, politically, environmentally and ethically aware.
- Have substantial knowledge of a wide body of case law and statute law.
- Are able to express themselves clearly and concisely.
- Are capable of critical, creative and reflective thinking.
- Have high levels of practical legal skills.
- Are lifelong learners, astute to the phenomena of change.
- Achieve excellence in their field.

My department further drew up a detailed list of essential practical legal skills which included legal drafting, legal research and writing, negotiation, interviewing and teamwork.

Mapping of assessment practices against identified skills and values

The next phase of the project was to find a way of embedding each department's list of graduate attributes in the teaching curriculum. Based on the proposition that assessment is a significant driver of student learning, my university decided to concentrate on the relationship between the desired values and skills of graduates, and the assessment tasks. Furthermore, a decision was made to confine the evaluation to the assessment tasks of compulsory subjects which all the law students were required to take. Accordingly, optional subjects were discounted even though they may have had assessment tasks which tested students on a desired attribute.

As the Director of Teaching of my department, I collaborated with an educational designer from the University's Centre for Teaching and Learning to match the existing assessment practices of the compulsory law subjects, with the values and skills listed in my department's statement of graduate attributes. This mapping exercise revealed a heavy concentration of assessment tasks which tested students on some of the values and skills. They included legal research and writing and the interface between gender, culture and the law. However, the mapping exercise found that certain other skills and values such as legal drafting, negotiation and teamwork were rarely assessed, if at all.

Consultation, revision and feedback

The results of the assessment mapping exercise were discussed at length at a departmental meeting. The meeting decided to reduce or omit the assessment of certain skills and values in some of the core subjects, and to increase or introduce other skills and values in other core subjects. Subsequently, the Centre for Teaching and Learning assisted those lecturers whose subjects were affected to modify their assessment tasks in line with the department's directives.

This is as far as my department has reached in this project. A range of staff and student feedback mechanisms is currently being considered for implementation. These mechanisms will monitor and determine the efficacy of the changes made to the assessment tasks of the core law subjects. Additionally, a representative group of recent law graduates from my university has been interviewed to appraise their views of the extent to which they have learnt the values and skills listed in my department's statement of graduate attributes. Four years from now, a similar group of law graduates will be interviewed to determine the extent to which the revised assessment regime has been successful in embedding the law department's stated list of graduate attributes into the curriculum. A comparison of the two sets of survey results should yield valuable insights into the assessment practices, both past and present, of the law department.

Conclusion

The project I have described has not been without its difficulties. Getting law lecturers to agree about basic matters such as the values and skills they consider essential in a law graduate, was a significant achievement. Likewise, a fair level of tact was needed to persuade individual lecturers to modify their existing assessment tasks. The promise and supply of assistance from staff members of the Centre for Teaching and Learning proved critical. But the hard work has been well rewarded. In particular, there has been an increase in collegiality among my department's teaching staff, created by a shared vision to produce the ideal law graduate, however idealistic or illusive that objective might be!

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Challenges of Teaching a Mixed Bag

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"You get what you get. On the first day you go into the class and there they are; it's up to you to teach them."[1]

However much experience you may have acquired as a teacher, one of the biggest challenges is preparing for a new module. This challenge is compounded especially when your cohort of students is not homogeneous (i.e. students from different disciplines, different levels, different backgrounds such as prior academic knowledge and work experience). Such differences often translate into different learning abilities, expectations and ultimately, learning outcomes.

This article is written with the experience of having taught a Singapore Studies module for the first time in Semester 1 of AY 2003/2004. I will focus on some of the problems encountered in teaching a heterogeneous cohort and the management of a module, particularly a new one.

Background

The Module. The module which I co-taught with a colleague was SSD 1203 "Real Estate Development and Investment Law". The purpose of this Singapore Studies module was not only to provide content knowledge but also to enable students to gain an appreciation of the critical issues confronting Singapore and develop analytical skills. The module offered the students an inter-disciplinary approach to the subject by looking at Singapore's historical, geographical and political development (See *http://www. fas.nus.edu.sg/ssm/*).

The Students. The following were the features of my cohort of 147 students taking SSD 1203:

- Students of various levels (Year 1–4) from various faculties in NUS—Faculty of Arts and Social Sciences, NUS Business School, School of Computing, School of Design and Environment, Faculty of Engineering and Faculty of Science;

- Only a minority had had previous exposure to a Law module;

- The foreign students did not have as much background knowledge on Singapore as the local students.

Some specific challenges and adjustments

Teething problems. In the initial weeks, several students asked me over email: "Why is there so much Law?" I responded by reminding them about the module's title. Though I was initially amused, the students' question revealed that they had opted for the module without realising what the module was about! This was somewhat disconcerting, as full details of the module were available on the Integrated Virtual Learning Environment (IVLE).

Obtaining references. Students were reluctant to make their way to the C J Koh Law Library where most of the listed references were. Instead, I was often swamped by requests for the materials to be reproduced for them. However, I steadfastly refused to provide these, thus reminding the students of the importance of independent and self-directed learning.

Just give us the answer! Since the module emphasised the development of analytical and legal argumentation skills, there were no specific outcomes or one 'right' answer to the tutorial questions. This made the students anxious about answering the questions initially. However, with practice and continued emphasis of the learning objectives of the module, the students became accustomed to the style of approaching the tutorial questions.

"But what do you want?" As a result of their unfamiliarity with the subject, students constantly posed this question to my colleague and I. This made me more aware of my expectations of the students and helped me ensure that these expectations tallied with the intended learning outcomes discussed above.

Difficulty of scheduling make-up classes. This was indeed a practical problem when a class fell on a public holiday. Some solutions included webcasting the lecture or scheduling a Saturday tutorial.

An enriching learning experience for all

Tutorials were bonding time. I decided at the beginning of the module that pre-arranging tutorial sub-groups to comprise students from different faculties will result in more productive discussions. With some simple ice-

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1. Davis, James R. (1997). *Better Teaching, More Learning. American Council on Education/Oryx Press Series on Higher Education.* p. 61.

breakers and self introductions, the initial awkwardness was overcome. The upshot was that new and lasting (cross-faculty) friendships were formed.

Varied perspectives. I received a myriad of fascinating responses to both the tutorial questions as well as questions posted on the IVLE. These responses reflected the students' different backgrounds. Students majoring in Economics would focus on the economic viability of a particular legislative provision, while those majoring in Sociology would highlight the sociological implications of a legislative provision. I could also tell which responses came from the Engineering and Science students. They would often post responses such as "Definitely the plaintiff would succeed in this case!" This could be due to their training to provide concrete and definite solutions to problems. In such cases, I had to intervene and point out that it's seldom a definite outcome could be forecast in legal disputes; rather, much depended on the technique of legal argumentation adopted. By doing so, I made all the students realise that developing skills in legal analysis and argumentation is more important than arriving at a specific solution or outcome.

Useful lessons for the teacher

In summary, it is not possible for any teacher teaching a new module to a heterogeneous cohort to foresee and be prepared for every situation which may arise. However, to enhance your teaching and the students' learning experience, the following are some useful information which you could bear in mind when teaching a heterogeneous group[2]:

- The students' age: this can mean differing levels of social and emotional development;

- The students' learning styles (visual, auditory, concrete or abstract): this can help you determine your teaching methods and learning activities to facilitate maximum learning for as many students as possible and;

- The students' thought patterns: this can help you understand better their cognitive development.

With this first and highly rewarding experience in teaching a cross-faculty module, I can appreciate better, the following:

"…the diversity of…opinions…does not arise from some being endowed with a larger share of reason than others, but solely from this, that we conduct our thoughts along different ways, and do not fix our attention on the same objects."[3] ■

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2. Ibid., p 62.

3. Descartes, Rene. (1637). 'Discourse on the Method of Rightly Conducting the Reason, and Seeking Truth in the Sciences'. Part 1. *http://www.4literature.net/Rene_Descartes/Discourse_on_the_Method/*. (Last accessed: 19 January 2004).

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Facilitating Teachers

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Most of us are familiar with the notion of facilitation. Yet, there isn't always consensus as to what facilitation consists of and its operational constraints. I personally have a preference for facilitation and whenever possible, have implemented this in teaching courses at the Law Faculty. What follows is my methodology regarding teaching by facilitation.

Of course, there is more to facilitation than just methodology and unfortunately, space constraints do not allow for a thorough exploration of these other aspects. For the purpose of this article, suffice it to say that teaching by facilitation operates on fundamentally different assumptions about the roles of the teacher, the student and the process and goal of learning than the more traditional form of teaching by lecture. Some, but not all of these aspects will become evident through the discussion of methodology. I would recommend a deeper exploration of these aspects for any teacher interested in teaching by facilitation. How then can one facilitate a class effectively? There are a number of steps to the process.

1. Pre-class preparation

There are two aspects of pre-class preparation. First, one must identify clearly the desired product at the end of the class. What content points should the class have obtained? What larger framework can be overlaid on these content points to aid understanding and memory? For example, in an action for negligence, what standard of care should the defendant be held to? What is the rule? What are the exceptions? Thus, this aspect of pre-class preparation provides the final design that the student is intended to see.

The second aspect of pre-class preparation is to identify a line of inquiry which will allow the student to think about the problem and to provide responses. Typically, I will use hypotheticals or analogies to help students relate to the subject matter. In this way, the subject matter becomes real for the students and their responses will come from being engaged in the inquiry as opposed to a theoretical one.

Following from the previous example of an action for negligence, a starting line of inquiry would be to provide

the hypothetical of an accident happening during a sports event, and the injured party being a student. The students are then asked what they would do, who they think should be held responsible and why. These questions will engage their thinking processes in the direction of the design one already has planned.

2. Facilitation during the class

Having set the design and starting point, the next step is to implement them in class. There are a number of aspects to implementation, some of which happen simultaneously.

First, it is important for the teacher to set an appropriate frame for a facilitative class. Usually, this will happen in the first class and in particular, two process points need to be made.

a. The teacher needs to set and communicate his/her expectations to the class. The students need to understand that the teacher intends to run the class by facilitation, which consists of questions posed by both teacher and students and responses coming primarily from students. It is also important for the students to understand that the quality of the outcome of the class is dependent on the quality of responses provided by students. In other words, a class taught by facilitation is a co-creative enterprise.

b. A 'safe' environment that is conducive for discussion needs to be established in the class. In other words, the students need to be assured that their opinions count, and that they will not be subject to ridicule either by the teacher or other students, no matter how off-the-wall their responses may seem to be.

These two process points are vital to the success of a facilitative class especially in the Singaporean context, where students are used to having information fed to them and may feel uncomfortable or threatened by being expected to participate in the class.

Secondly, the teacher can begin the process of inquiry by presenting the hypotheticals and questions identified earlier. S/he then waits for responses. It is important at this point to remember that whatever response one gets from a student is a good response. Any student who ventures a response is often taking a risk and this should be encouraged.

3. Managing students' responses

At this point, there are a number of strategies which a teacher can run on the responses received.

a. *Expansion on a point.*

The teacher can use this to invite class discussion on a point made. Open-ended questions like: "Why is this important?", "What is the logical consequence of this argument?", "In what situations would this argument apply?" or "In what situations would this not apply?" The idea here is to flesh out the initial point made and to contextualise it. This is important as the initial response, though often vague and undeveloped, has scope for expansion.

b. *Finding alternatives to a point.*

As mentioned earlier, it is important that any response,

even one that is not right, be validated. However, when a point made isn't 'quite on target', the teacher can respond by saying "Ok, this is one view, what other views or approaches might there be?" By seeking alternative views, the pressure to give the 'correct answer' is taken off the student. The teacher can then assist the class to build on the initial response and arrive at a more valid point.

c. *Flagging a point.*

Sometimes, a point made does not fit in the present discussion but might be relevant in a later discussion. The teacher can flag such points for future discussions by saying "This is a good point and I'd like you to keep this point in the back of your mind and bring it up again when we address that issue later. However, the focus right now is on this topic." By doing so, the teacher validates the contribution and leaves the loop open for future discussion and learning.

d. *Linking points*

Typically, as a discussion progresses, many of the points raised can be relevant and related to one another. The teacher can choose to link these points together to reveal more of the final design. In essence, the teacher as a facilitator plays a critical role by creating linkages between the discussion points which will eventually form the framework of the students' understanding. Of course, needless to say, the additional responses made by the class in relation to each of these strategies can also be subject to the reapplication of these strategies.

e. *Completing the framework*

Finally, there comes a point in the session where many, if not most of the points have been brought up and discussed but the students may not yet see how these points fit together, or there may be one or two missing pieces which have not surfaced. The teacher can now fill in the missing pieces and pull the threads of the discussion together. This involves making explicit the framework from which the teacher has been operating. The students can then see where and how the points they have raised fit together. Furthermore, the students, having contributed to the construction of the framework, are more likely to remember the relevant points.

Facilitation as a method of teaching deserves much mention. Perhaps the most important aspect of teaching by facilitation is that it allows students to become actively engaged in the process of constructing their own learning and thereby increasing recall and understanding. Yet, teaching by facilitation is a challenging method for both the teacher and the students. It requires the teacher to shift away from the traditional ways of thinking about education and to treat students as peers. This experience can be equally strange to students who are used to a more tradtional form of teaching method. Thus, setting appropriate frameworks for the facilitative class is vital to its success. Despite these challenges, the benefits from teaching by facilitation make overcoming the challenges worthwhile. ■

Changing Winds and Shifting Sands:
From Teacher-centred to Learner-centred Institution

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This article is divided into two parts: the first part shows the difference between teacher-centred and learner-centred instruction and highlights the latter, while the second presents the practical applications in implementing learner-centred instruction.

Looking back at the past century, it's interesting to note that a number of new theories on teaching and learning have emerged. Among those theories which have been popular and become the bases of the theoretical foundations in the field of education are socio-cultural and constructivism. The socio-cultural theory of Vygotsky posits that social interaction plays a fundamental role in the development of cognition (Kearsley, 1994b). Constructivism, on the other hand, states that learning is an active process in which learners construct new ideas or concepts based upon their current/past knowledge (Kearsely, 1994a). If we go deeper into these theories, we will come to an understanding that they focus on the learner, while the teacher's role is that of an inquirer, observer, facilitator and creator of 'rich' learning environments from which the learner can make his/her own discoveries. These two perspectives (socio-cultural and constructivism) became the foundation of learner-centred instruction, which is often contrasted with the teacher-centred approach. With the emergence of different theories in education, one may question: Is there a currently recognised approach that is a generally accepted norm in education? The answer is yes. It is an approach that puts the learner at the heart of teaching and learning—learner-centred instruction.

Teacher-centred vs. learner-centred instruction

The Faculty Development Institute of Virginia Polytechnic Institute and State University (2002) differentiates teacher-centred from learner-centred instruction based on the following five variables in Table 1:

Brown (2001) summarises the differences between teacher-centred instruction and learner-centred instruction by highlighting the latter, which includes:

1. Techniques that focus on or account for learner's needs, styles and goals,

2. Techniques that give some control to the student (e.g. group work or strategy training),

3. Curricula that include the consultation and input of students and do not presuppose objectives in advance,

4. Techniques that allow for student creativity and innovation,

5. Techniques that enhance a student's sense of competence and self-worth,

Barrows (1994) and Feltovich *et al.* (1996) point out the potential benefits of the learner-centred approach namely, increased student motivation, active participation in the learning process and better learning. Others like Bostock (1997) and Scardamalia & Bereiter (1992) claim that students under learner-centred instruction as compared with non learner-centred instruction students, may be able to apply the knowledge better, have a deeper understanding of the materials, develop more cons among the concepts, and acquire greater critical thinking skills.

Practical applications

Reflection. The first and the most important step in creating learner-centred instruction is to examine our philosophy of teaching and learning. We have to look back at what we have done in the classroom. This includes revisiting the approaches, methods and strategies we have employed.

Specifically, we have to ask a question: Are our methods and strategies anchored in the principled approach in teaching and learning? In line with this question, *http://www.teachervision. fen.com/lesson-plans/lesson-4786.html* offers some useful suggestions:

- Initiate collaboration with other educational professionals.

- Locate and share studies that document successful learner-centred classrooms.

- Attend conferences and workshops geared toward learner-centred topics.

Based on my experience as a teacher, administrator and researcher in a private educational institution in Southeast Asia, many teachers exert little or no effort at all in doing the above-mentioned activities. The reason is neither the non-availability of research materials and educational experts nor the lack of funding, but it is simply the 'I know that already' mentality. Such teachers tend to think: Why should I waste my time reading educational studies, talking to other teachers and attending seminars when 'I know them already'? As educators, we should not think this way. Let me quote what Brown (2001) says to second/foreign language teachers, which I believe is true and useful across curricula:

Table 1

	Teacher-centred	**Learner-centred**
Transmission of Knowledge	Knowledge is transmitted from instructor to students such that what an instructor says is automatically internalised and learned by the students.	Knowledge is constructed by the students through gathering and synthesising information and integrating it with skills such as inquiry, communication, as well as critical and creative thinking.
Use of Knowledge	Emphasis is on the acquisition of knowledge (frequently the memorisation of information) outside the context in which it will be used.	Emphasis is on effectively using and communicating knowledge to address problems similar to those that will be experienced in real life.
Instructor's Role	The instructor is primary information giver and performance assessor.	The instructor is coach and facilitator. Both students and instructor assess learning performance together.
Assessment	Assessment is used to evaluate learning outcomes.	Assessment is used to diagnose learning problems and promote further learning, in addition to evaluating learning outcomes.
Learning Culture	Learning culture is competitive and individualistic.	Learning culture is cooperative, collaborative and supportive.

The way you understand the language-learning process—what makes for successful and unsuccessful learning—may be relatively stable across months or years, but don't even feel too smug. There is far too much that we do not know collectively about this process, and there are far too many new research findings pouring in, to allow you to assume that you can confidently assert that you know everything you already need to know about language and language learning.

Group Work. Group work or cooperative learning is solidly grounded in research principles. A 1981 meta-analysis of 122 achievement-related studies reported that Cooperative Learning (CL) promotes high achievement rather than competitive or individualistic learning across all age levels, subject areas and all tasks except rote learning and decoding type of tasks (Johnson *et al.*, 1981). Brown (2001) suggests that the group activities—role-play, simulations, drama, jigsaw, information-gap, problem solving and decision-making, brainstorming, interview and projects—can be effective in the classroom if implemented properly. He further makes some suggestions on how to plan for those group activities:

6. introduce technique,

7. justify the use of small group for the technique,

8. model the technique,

9. give explicit detailed instructions,

10. divide the class into groups,

11. check for clarification, and

12. set the tasks in motion.

Conclusion

The focus of learner-centred instruction—having learners at the centre of the teaching and learning process—poses a big challenge to every classroom teacher. This entails maximising the full potential of the learners by 'empowering' them in the classroom. This is not an easy task because it changes our beliefs about teaching and learning and pushes us to think of strategies that can give learners some control of their learning. For those who have been practising learner-centred instruction, the challenge lies on exploring other ways that will allow for learner creativity and innovation, and perhaps sharing your insights with other classroom teachers.

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International Conference on Teaching and Learning in Higher Education

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Registration
Registration for the conference is S$500 if payment is made on or before 1 October 2004 and S$550 if payment is made after this date. The fee will cover a copy of the conference proceedings, admission to all sessions, conference banquet, lunches and refreshments.

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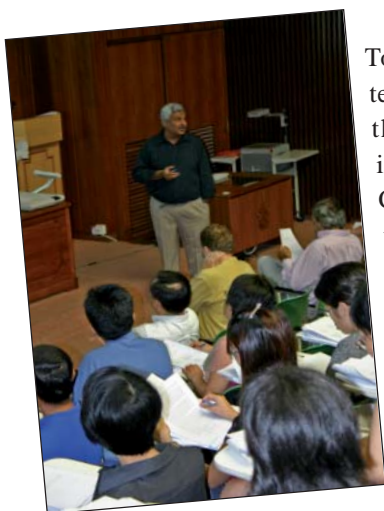
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CDTL's Workshop on Research at Raffles Institution

To help secondary and tertiary students acquire the capacity to engage in independent research, CDTL conducted a workshop on Introduction to Research on 24 & 25 March 2004 at Raffles Institution AV Theatre for 117 teaching staff at Raffles Institution to help the teachers develop a broad understanding of the following topics:

Prof KP Mohanan, together with Prof Alex Ip, A/P Aslaksen, A/P Anjam Kursheed, Dr Robin Loon & A/P Peter Pang addressed this workshop on the topic of research.

1. Knowledge and Inquiry
2. Purpose of Inquiry
3. Grounds of Inquiry
4. Reasoning from Grounds to Conclusions
5. Norms and standards of Justification/Proof/Argumentation
6. Literature Search
7. Communication
8. Exercises
9. Projects, extended essays and theses
10. Ethics of Research ■

Welcome!

CDTL would like to welcome as Affiliates the following:

Associate Professor Bernard Tan,
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Dr Tan Kay Chen,
Department of Electrical & Computer Engineering

We would also like to welcome **Ms Sharon Koh**, who joined us as Publications Officer in May 2004. ■

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Teaching & Learning
HIGHLIGHTS

School of Design and Environment
Teaching Activity at the School of Design and Environment for Semester 2, Academic Year 2003/2004

'Live until old, learn until old' is an approximate translation of a Chinese saying on which Associate Professor Seah Kah Heng based his talk on at a teaching seminar organised by the Departments of Building and Real Estate on 21 April 2004.

Carrying a backpack which contained literally a bag of tricks, Professor Seah showed the staff an array of the tools he used to interest his students in the courses he taught at the Manufacturing Division of the Department of Mechanical Engineering. To make his courses more real and relevant for his students, he used ordinary items like clothe hangers, hoses, raincoat, water bottles and even an army helmet, so that students could actually see and feel the connection of what they were learning with the real world and increase their capacity for lifelong learning.

A vibrant and enthusiastic Q & A session

Professor Seah found that using such everyday items would enable students to make connections between theory and practice and thereby increase their interest in his modules. When framing tutorial and examination questions, Professor Seah would include 'real' constraints such as the cost and weight of materials used to determine the viability of solutions suggested by students. Following his talk, there was a vibrant question and answer session with staff members who described his talk as 'very relevant' and 'informative'. ■

Faculty of Science
Lecture Game Show

As a form of revision for their mid-term test last February, students of GEK1508/PC1325, "Einstein's Universe and Quantum Weirdness" were treated to a lecture quiz inspired by the TV game show, 'Who Wants to be a Millionaire?' The format of this quiz was 15 multiple-choice questions of ascending difficulty, similar in scope to what would appear in the upcoming test. Although only one lucky student was selected to take part in this quiz, it was hoped that everyone in the audience would also attempt the questions at the same time and hence benefit from it.

As in the TV game show, there were three lifelines: '50/50', 'Consult a Friend', and 'Ask the Audience'. It was certainly an exciting show, as the contestant methodically cleared the questions one by one. Naturally, the suspense in the lecture theatre mounted as the contestant used up his lifelines and the questions got more and more challenging. Unfortunately, the penultimate question proved a little too tricky, and

The contestant of the game show held on 17 February 2004, Tang Anh Quy (left), receiving a letter of participation from the lecturer of GEK1508/PC1325 and game show host, Dr Edward Teo.

so there was no 'millionaire' this time round. Of course, there was never a million dollars at stake, and indeed the real winners of the game were all the students present. It was a fun yet effective way for the class to revise the lecture material. ■

Faculty of Engineering
Project-based Learning in Process Dynamics and Control

In the recent offering of the module CN3121 "Process Dynamics and Control (PDC)" to second year chemical and biomolecular students (enrolment: 235), several changes were made to the pedagogical style. One key change was the introduction of a project component. The intention was to foster independent learning skills in the students and to reinforce the classroom lectures with 'simulated' real world experience. Students were provided an option of modeling and developing control systems for multivariable processes (simulation models of two chemical 'plants' and three diabetic 'patients' were provided to the students in MATLAB/SIMULINK) or to choose a research paper (a list of 70 research articles was provided) and prepare a critical summary, verify the results provided in the journal article, track the recent progress in that area, current industrial practices etc. This project involved an enormous investment of time and effort on behalf of the students, teacher and the tutors. Students responded admirably to this challenge and (from student-teacher interactions and their project reports) it appears that they have benefited a lot in terms of understanding the concepts, critical analysis of results, technical report writing, working with and learning from peers etc. It has been a very satisfying experience for this teacher despite the huge amount of effort spent on student consultations and the grading of reports. ■

Making Your Teaching Creative and Interesting

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Introduction and context

In this short paper, I offer some reflections on certain findings from a research project which seeks to understand how teachers do what they do to make their teaching creative and interesting. Details of the research and methodology are beyond the scope of the paper.

Though what constitutes 'creative' and 'interesting' can be subjective, they are often considered important attributes of quality teaching in general. As Tuckman (1995) has pointed out, "…defining or describing the 'competent' teacher is neither an easy nor an obvious task" (p. 57). Similarly Ornstein (1995) argued, "…few facts concerning teacher effectiveness have been established" (p. 77).

What do we mean by being creative and interesting in the context of teaching?

Creative teaching resembles creativity in any other domain. Primarily, it involves the combining of existing and new knowledge to create some other knowledge to get a useful result. As Amabile (1996) suggested:

> A product or response will be judged creative to the extent to that (a) it is both a novel and appropriate, useful, correct or valuable response to the task at hand, and (b) the task is heuristic rather than algorithmic. (p. 35)

Teaching is certainly heuristic, and such 'responses' in the context of teaching are anything that contribute to student learning in a positive way (e.g. building rapport, making learning meaningful, improving the students' learning state, enhancing students' beliefs). Not only is creative teaching often a result of a teacher's conscious planning, it is also the consequence of what I refer to as *situated invention*—a teacher drawing on his/her existing professional knowledge and improvising it to meet the demands of an unforeseen situation—as teaching is a dynamic human encounter in which much of the student responses cannot be predicted in advanced. Thus, teachers often have to think on their feet, quickly reframe what they are doing and deal with the perceived emerging reality. When situated invention occurs, a teacher has been creative at that point in time. Sometimes (but not always) this produces a desirable result. In many ways, this process of creating ideas is analogous to Schon's (1987) notion of 'artistry', which he defines as:

> …the kinds of competence practitioners sometimes display in unique, uncertain and conflicted situations of practice. (p. 22)

The new knowledge that results from the creative act is now a *resource* for the teacher to use in the future. In other words, it becomes part of his/her personal stock of professional knowledge and contributes to developing expertise.

From my observations of video-recordings and personal interviews with many teachers, there are some teachers who continually try to be creative (either in their lesson plans or in the flow of dialogues during the lesson), and others who recalled situations during lessons when an idea (e.g. a powerful metaphor, a insightful question, a novel example) sprang to their minds and translated this into productive communication to the students. Sometimes when an idea cannot be developed *in situ*, it is later reflected and elaborated on, and subsequently developed and used as a teaching/learning resource for future lessons. Sadly, some teachers give little thought to make their teaching interesting; their focus is simply on relating the subject content to stated learning outcomes. Further, many teachers are more preoccupied with covering the content rather than making the learning process interesting for the students. As one teacher commented, "the content must be covered".

In terms of what constitutes as 'interesting', I take a normative view. If students perceive a teacher as being interesting, then he/she is interesting (at least to the students involved). The more interesting question (no pun intended) concerns how these teachers do what they do that result in students perceiving them as 'interesting'.

Teachers who continually seek to make their teaching interesting are inevitably creative

Did the above header get your attention? I hope so. Cognitive psychology, neuroscience and professional experience clearly identify 'interest' as central to the processes of attention, motivation and learning. To quote Csikszentmihalyi (1990) in this context:

> The shape and content of life depends on how attention has been used. …Attention is the most important tool in the task of improving the quality of experience. (p. 33)

Csikszentmihalyi's statement is not particularly surprising given the nature of teaching. Effective teaching is probably one of the most difficult jobs. To encourage motivation, promote self-esteem, gain rapport and make learning meaningful for a wide range of personalities and competence levels require massive effort and skill. Making teaching interesting—which really means making learning

meaningful for the students—is a continual challenge for teachers.

Invariably, teachers differ in terms of their own motivations and attributes in this area. Some teachers continually look for ways to make their teaching interesting through either systematically planned lessons or situated inventions as doing so is consistent with their values and beliefs.

It is important to mention that in addition to the students, teachers can benefit from the process of making learning interesting for the students. This is because the process requires the teachers to continually combine elements of their existing professional knowledge with applications in the classroom. By doing so, teachers will create new knowledge, develop better skills of communication and be more competent in actual practice.

What constitutes creative and interesting teaching?

When students perceive (and rate) teachers as interesting, caring, knowledgeable, etc., these are constructs that the students derive from the sensory experiences provided by the teacher, but not necessarily what the teacher intends. Bandler & Grinder (1990) pointed out: "The meaning of your communication is the response you get" (p. 6l). From the research so far, the following are some ways in which teachers can make their teaching interesting for students:

- Communicate in a clear, concise, engaging and friendly manner with the aim of achieve rapport with students
- Imbue students with positive beliefs about self and learning
- Enhance student's psychological states
- Make learning meaningful for the students
- Engage students in challenging activities with achievable goals
- Use stories and metaphors to create emotional anchors

- Use relevant real world examples to sustain students' interest
- Use humour constructively
- Use varied audio-video materials to engage senses

It is important to note that the above list presents only a sterile view of what really occurs in classrooms when teachers are making learning interesting and being creative. Various other teaching materials are strategically combined (both consciously and tacitly) to create sensory experiences, which can energise and motivate students to participate fully in the learning process. Perhaps the following metaphor might convey the essence of this process:

> If we visualise each teaching resource as a key on a piano, the interesting and creative teacher typically plays a consistently good tune. Occasionally, he/she improvises the tune with the desire to provide something new to engage the audience's senses. Likewise, creative teaching occurs when a teacher 'improvises' his 'tune' (knowledge), to make a productive contribution to the learning process.

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A Quick Self-check

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How do we balance the demands of the University, students, colleagues and family? How do we satisfy principle and conscience when the vectors of our multiple audiences seem sometimes complementary, sometimes antithetical? How can we operate with equity and equilibrium?

One way to manage this dilemma is to unify these apparently opposing concerns under one umbrella, so that they are aligned and hence synergised into one whole.

Teaching and professional concerns surpass their seeming contradiction when viewed at a higher level of purpose.

University teaching is geared towards shaping tomorrow's leaders. And to be professional, in my mind, transcends the bounds of its traditional meaning. To me, to be professional is *not* to abuse our freedoms; to operate with unquestionable trust and integrity; and adhere to both articulated and non-articulated codes of conduct. These concerns can be easily harmonised.

Every profession has its code of conduct that enshrines the general first principles for appropriate behaviour. In our case, the NUS Code of Conduct (HR 083/03 at *http://www.nus.edu.sg/corporate/research/*) serves this purpose.

Briefly, our Code is based on 3 principles:

1. Personal and professional integrity (covering items such as conscientiousness, plagiarism, confidentiality, accepting gifts, personal and professional relationships, conflict of interests, research integrity, and guidelines and policies governing the use of human and animal subjects).

2. Respect for people (covering exemplary decorum, due credit and proper acknowledgment).

3. Respect for the law and University governance (covering legality).

All Codes and laws convey parallel messages. But a Code attempts to manage the grey areas. Hence its interpretation is subjective and can differ according to culture and value system. Despite this limitation, we can be professional in all our actions, whether simple or significant, by focusing on the universals.

Let's do a simple self-test. Are we using smudged transparencies or slides with illegible and misspelt words with eye-straining colour combinations? Do we defend this by saying that we are not technology-savvy? We can be professional through simplicity in our visuals, and hence be exemplars to students.

The questions are endless. Do we badmouth our colleagues and institution? Do we give due credit to our students' research? Some departments have even published and showcased their meritorious works. Do we caution students against plagiarism? Do we maintain confidentiality especially in examination matters? And do our personal and professional relationships run into conflict?

Next is the issue of quality versus quantity—the larger the class size, the larger the strain in maintaining performance standard. Is it because we are rigidly polar in our approach? Then we should have flexible approaches in our delivery to cater to different audience sizes, room constraints and class character and not adopt a one-size-fits-all approach.

Another issue we face is the epistemological-pedagogical balance. Content, process, thinking and learning can all be managed by comparing our assumption of how much the students (should) know with how much we want to explain or tell them. Some lecturers err by spoon-feeding (i.e. telling and explaining everything and flooding students with notes), creating the very lethargy, indifference and total dependence on us that we ourselves abhor in students. Where then are their reading and thinking on the topic?

The other extreme is equally culpable. Some lecturers return students' queries without clear answers all the time to the point of frustration. Some agree with every response from the students, whatever they are, either for popularity or in fear. Yet others in the name of fun dispense a disproportionate time to humour and laughter at the expense of learning. While the buzz in class during an activity can indicate the excitement of the students, humour should be tempered and balanced to sustain interest and academic rigour.

Our self-test continues into deeper waters. Do we ourselves grasp the nascent meanings, innuendos and ramifications of the concept of student learning? We can attain higher levels of students' thinking and performance by using models such as Bloom's Taxonomy. Some of us may not be using it because we may not be familiar with it; or we fear intimidating students on the first day of class. By exposing them to these ideas we can reduce the students' uncertainty and raise their anticipation for the course by our reassurances to guide them. Hence, I make it a point to introduce the Taxonomy in every first lesson.

The next scenario: Are we preparing students for examinations or for the workplace? This inherent opposition may be reconciled if examinations ultimately, and perhaps indirectly, test students' higher-order skills for the workplace. This is what I mean by unification and alignment and how this approach can manage our self-created paradoxical constructs that shape our paradigms.

One way that NUS responds to the global demands for a broad-based education is by crystallising General Education Modules (GEMs), Cross-faculty Modules (CFMs) and the like as a platform for our graduates to acquire a multidisciplinary spectrum. But how do we get students to engage in multidisciplinary thinking if we ourselves are rigidly specialised; to be critical if we swallow without question; to be "open-book" if we remain closed ourselves?

Professionalism entails artistry, and our value ascends when our students enjoy learning. Students respect and admire us when we impart knowledge that is novel, share experiences and possibilities, and make them think and wonder beyond the course and examinations. These are the teachers and the modules that students remember and love. This is where they are inspired to select a specialisation because of us. This is where we make a difference to students, ourselves and NUS firstly, and to the larger society consequentially. This is what is meant when we say we mould young minds, shape the future and grow in the process. This is the greater reward for all.

In the NUS President's Circular No. 2003–11, dated 29 November 2003 (*http://my.nus.edu.sg/SAPPORTAL/*), Professor Shih Choon Fong challenged the University "to question our way of doing things as well as its underlying assumptions". Do we aim to discover and manage the uncharted territories within ourselves? If so, do we then catalyse self-change?

My experience is that rules and Codes merely echo our silent principles and inner voices. Doesn't our conscience tell us exactly the same thing as these Codes? And do we follow? That is the ultimate yet simple question. ■

Meaningful Online Discussions

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One issue facing educators with large classes is how to create meaningful discussions amongst students. At Dawson College in Montreal, Canada, I run online chat room sessions which have met with great success. The purpose of these chat room sessions is to give students the opportunity to work on assignments or discuss the subject material in greater depth. With the help of the chat room sessions, the 'burden' of teaching is shifted from the teacher to the students. Here is a brief overview of how I set this up.

First, we use the WebCT[1]—a course management system at Dawson. This platform has a chat room where students can log on to any one of the four 'rooms' for a period of 90 minutes any time during the week except Fridays. They can use it at 10am on Monday or 3am on Wednesday if they wish. The rush hour is usually around dinner time. In order to ensure active participation by all everyone, I only permit a maximum of four students per session. Students can work with whomever they wish. I have considered matching stronger students with weaker ones but have decided that this would not be fair to the former. However, others may view this differently.

The online class is in place of an on-campus session. At their scheduled time, students log on and work on the weekly assignments together. They are required to spend about 80% of the 90 minutes working on the assignments in groups. They can chat about whatever they want for the rest of the time. I am able to monitor their conversations in real time if I wish.

Afterwards, students with questions can post them in a discussion group which all other students can look at. Most of the time, I find that students have similar questions. I post my replies to students with similar questions throughout the week.

Friday is free time on the chat rooms and the groups are permitted to use any of the free rooms for up to a half-hour to finalise their answers. The groups then submit their assignments to me via the WebCT's email by midnight Friday. I return their work in a few days via WebCT's email.

In the following sections, I would like to explain a few issues in greater detail and make a few suggestions regarding WebCT.

Why logged chats? First and foremost I want to see what the students are up to. From past experience, I have found that going through the logs allows me to 'diagnose' students'

problems. Furthermore, the fact that the students know that their discussions will be read 'encourages' them to stay focused on their work. I realise that the monitoring of chat rooms might seem creepy, voyeuristic or Orwellian, but the students do not seem to mind and they are told repeatedly that their conversations will be monitored either in real time or later in logged form.

Sometimes I follow the students' chats if I am on the computer. I will answer their questions or interject when I see something of interest. Professors herding very large classes might be able to arrange it so that a teaching assistant (TA) is always monitoring discussions in order to answer questions immediately.

I require students to be noticeably civil at all times when they use the chat rooms. While most students are respectful towards their peers, there is always the potential for unpleasantness in the chat room. As I am aware that 'toxic' environments are destructive, I use disciplinary tools when necessary. However, what is problematic is that friends sometimes call one another the vilest and foulest things. Though I cannot tell whether they are joking, I tell them not to say anything that might be misinterpreted. Finally, all conversation is carried out in languages understood by most students and myself. This is of particular importance to educational institutions with a rich ethnic mosaic.

Another interesting tool is the Whiteboard—an online real time blackboard—which allows the students to create online real time diagrams with an inexpensive electronic tablet and pen. WebCT 4 also has a math editor for those needing such a tool. With these tools, it is also possible to create assignments and quizzes which are corrected by the computer and automatically entered into WebCT's grade book. If a TA is helping to administer the course, you can give the TA as much or as little control and access to the course as you wish. Students can address questions or send assignments directly to the TA's WebCT mailbox.

I also use the discussion board to post answers to F.A.Q. I often discover common problems after reading the students' chat room discussions. I then post my explanations on the discussion board in order to resolve the problems. At the end of the semester I look at all of the problems which have popped up and revise my lecture notes accordingly to clarify the things for the next batch of students. Finally, it is important to note that the total amount of time 'teaching'

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1. Most of the features in the WebCT are also available in their competitors such as the Blackboard.

online is identical to the amount of time I spend in class teaching.

I find that most students love this way of online learning; many like the fact that they do not have to come to campus to learn. Such a form of online learning also forces students to work on the problems in small groups. Instead of sleeping or downloading e-mails in a monster teaching hall, students are now actively engaged in discussing and doing their assignments. Furthermore, the responsibility of teaching has shifted from the teacher to the students. This transformation may be to teaching what the printing press was to Plato. ■

Web-based Digital Archive of Selected Architecture Students' Projects

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Introduction

To increase the community's knowledge of architectural design by utilising the state-of-the-art IT infrastructure and high-speed network in NUS, the Department of Architecture has established a web-based digital archive (*http://www.arch.nus.edu.sg/resources.html*) of selected projects done by architecture students. Though it is meant primarily as a knowledge database for the students to study and learn from previous projects done by their peers, staff also benefit from this database particularly when the publications that showcase the students' work across all programmes and levels have to be prepared. The data in the digital archive currently comprises works of the core design studio modules, where each student has to create and develop his/her own architectural designs. All the works have been converted into digital data using the most common data formats.

How it was done

The CD-ROMs submitted by the students were scanned using the tools Catfish and Thumbs. The former tool produces the index of files and the latter, the thumbnails for previewing. These two files and information on 'Module Code', 'Academic Year', 'Semester', 'Studio Leader', 'Student's Name' and 'Matriculation Number' etc. were compiled in an MS Access database file. Search criteria and graphical user interface set by the Digital Archive Committee and the ITU of the Department of Architecture made the database searchable via the web. In the subsequent sections of this article, I shall be demonstrating how a user can search for a particular student's work in the archive.

Step 1: Entering the search criteria

The website allows several search criteria to be entered. For example if one would like to know about Dr. Stephen Wittkopf's best piece of work in architectural design studio, the user has to simply enter the following search criteria such as 'Grade', 'Studio Leader' and 'Module Code' as shown in Figure 1. The remaining fields can be left unspecified.

Step 2: Viewing the records found

Once the criteria are entered, the user can hit the search button. This will bring the user to a page (Figure 2) showing

Figure 1- Step 1: Entering the search criteria

Figure 2 - Step 2: Viewing the records found

results such as 'Student's Name', 'Matrix Number', 'Academic Year' and 'Semester' of matching record(s). Links that allow the work to be previewed and retrieved in full detail have been added.

Step 3: Viewing a PDF file using the 'Project Preview'

The field 'CD-ROM/Disk Number' indicates the storage media that contains all data in full detail. This media can be either mapped to a network drive or loaned from the Department. At present, due to copyright issues, the storage

media can only be loaned from staff. However, students and other users can preview the data by clicking on the 'Project Preview' link. This will launch the Adobe Acrobat Reader and allow the user to view a PDF file which depicts thumbnails of all data available for a particular student's work. It comprises a short description of the design, the final presentation boards and raw data that has been produced along the project. Furthermore the 'File Name', 'Size' and 'Location' of the data file are displayed as shown in Figure 3.
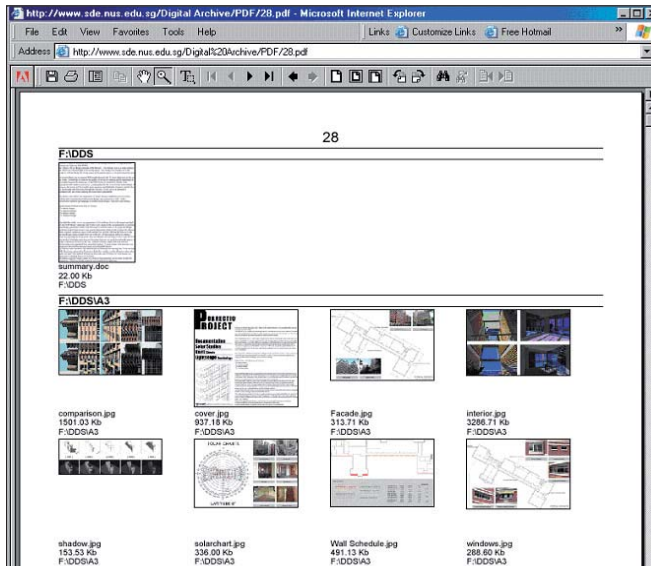
Figure 3- Step 3: Viewing a PDF file using the 'Project Preview'

Figure 4 - Step 4: Browsing the Project File Index

Step 4: Browsing the Project File Index

An optional index of all files can be retrieved to familiarise oneself with the structure of the folders and files for a particular match. Figure 4 depicts the text file that appears when the user clicks on 'Project Information'. In future, more criteria such as 'site and building type' and 'related sources' shall be considered.

With the convenience that comes with features like viewing, sorting and collecting of data, the digital archive has been a great support to the publication of the Department's annual folio. In addition, the archive has helped to establish a gallery of printed posters of selected works along the corridors of the architecture building (Figure 5).

Conclusion

In future, more keywords will be added to allow students to retrieve designs of a particular site or building type done by previous students. This will greatly enhance the students' knowledge of design precedents which is important for any design development. The internet-based access to the archive also allows external examiners (especially those outside Singapore) to review the students' work anytime anywhere. As we continue to develop and work on the archive, other modules such as dissertations and even staff's products and publications may be embedded or linked eventually. ∎

Figure 5 - Posters of selected works along the corridors of the achitectural building