# Medical Education: Enhancing Learning in the **Affective (Feeling) Domain**

**Professor Lee Eng Hin**
Director, Graduate School of Medical Studies

## Introduction

In recent years, medical schools have been faced with tremendous educational challenges caused by rapid changes in the healthcare scene. With the explosion of medical information and advances in medical technology, medical students are now expected to acquire large amounts of knowledge and skills. In addition, owing to increased affluence and the universal availability of medical information on the Internet, today's patients are better informed about their illnesses and tend to have higher expectations of their doctor's ability to advise them appropriately. Given such an environment, we, as medical educators, have to ensure that our medical graduates not only acquire the requisite knowledge and skills to have a sound scientific basis to practise medicine, but our students must also acquire the ability to communicate well with their patients and colleagues, and develop appropriate professional attitudes and ethical principles.

## Educational Outcomes of Learning

For almost 100 years, our medical school has been producing highly competent doctors. Our graduates are recognised by the General Medical Council of the United Kingdom for full registration. They have done extremely well whenever they go overseas for specialty training, thus earning international recognition for our high standard of undergraduate and postgraduate medical education.

Although we are recognised internationally, traditional medical education has focused mostly on the development of cognitive and psychomotor skills to ensure that the end product is a technically competent doctor equipped with the desired knowledge and skills to practise medicine. Today, the 'complete doctor' needs to have more skills to be able to relate well to his/her patients. The *educational outcomes* of learning as applied to *medical education* can be classified within *three learning domains*:

- *Cognitive* (*knowing*) domain: Focusing on knowledge acquisition and intellectual skills and abilities (e.g. the diagnosis of disease, strategising treatment options).

- *Psychomotor* (*doing*) domain: Relating to skills that require varying levels of well-coordinated physical activity and precise manipulative procedures (e.g. simple

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suturing of an open wound, performing an endoscopic examination, performing sophisticated surgical procedures).

- *Affective* (*feeling*) domain: Dealing with feelings, emotions, mindsets and values, including the nurturing of desirable attitudes for personal and professional development (e.g. allaying the concerns and fears of patients, displaying empathy for the relatives of a patient who has just died, displaying mutual trust and respect in working with members of the healthcare team, upholding high ethical standards in practice).

### Changing Needs and Changing Paradigms

In this digital era of information explosion and rapid advances in medical sciences and medical technology, it is imperative for medical educators to reappraise and to review the undergraduate medical curriculum to match the changing educational paradigms. The traditional role of the medical teacher as the 'sage-in-centre stage' and as the 'fountain of knowledge' who simply transmits much factual information through abundant lectures is no longer tenable.

"Today, imaging techniques, colour reproduction, cheap printing, computer simulations, video-taping, computer databases, and Internet facilities **provide students with excellent opportunities to learn without requiring a teacher to transmit the available information.** Students may no longer rely on a teacher's knowledge as the main source of information." (Bohuijs, 1998)

The medical teacher now needs to take on additional roles; he/she has to be the designer and manager of the learning environment who facilitates, guides and optimises student learning through nurturing the intellectual and learning process.

"An academic who only presents facts is not a teacher; a **teacher** is one who **nurtures** the **learning process** and thereby modifies behavior and patterns of thinking for a lifetime." (Woosley, 1997)

Thus, the educational paradigm needs to shift from highly teacher-centred instruction to student-centred learning. Such a shift would require students to take on greater initiative and responsibility to direct and to manage their own learning as well as their educational, personal and professional development. This poses a major challenge to medical teachers to ensure that the desired student attitudes and mindsets to learning are nurtured and developed during the educational preparation of students in medical school. Thus, medical education today needs to *foster* and *nurture* the *development of self-directed learning skills* that will lay the foundation for students to want to *engage in life-long continuing self-education* so essential to medical practice, especially in this millennium.

### Communication, Professionalism and Ethics

"**Attitudes** of mind and of behaviour that befit a doctor should be inculcated, and should imbue the new graduate with attributes appropriate to his/her future responsibilities to patients, colleagues and society in general." (General Medical Council, U.K., 1993)

The nature of doctors' work and their work environment requires them to *interact closely* with members of the healthcare team and their patients. Since patients today are better educated and are generally more informed about diseases and health matters through the Internet, the dynamics of the *doctor-patient relationship* has therefore changed. Patients now expect, and may even demand to know more about their sickness, the treatment options available and costs involved. In other words, there is now an even greater need for doctors to be able to effectively *communicate* with and display a much more *caring attitude* in the management of their patients. A commentary in the May 2001 issue of the *Alumni Newsletter* clearly highlights this point:

"As medical students, we are taught and taught a voluminous amount of knowledge that has been acquired through the practice of medicine. We learn all this and we think that we are now well equipped to pass examinations and to proceed to practice as physicians, dental surgeons and pharmacists. But **what we need most as practitioners** of our profession is **communication**, and this is **never taught to us**. …We learn to communicate better with our patients with the passing of time and **our patients appreciate us better as we communicate and explain to them** their medical and dental problems and purpose and function of the drugs in their prescription. The **problems** faced with in the **practice of medicine** are **often related to** the **lack of communication between the doctor and his patient**. This **lack of communication often** is the **cause of misunderstanding** that could **lead to unnecessary litigation**."

In the educational preparation of medical students then, it has become more important to ensure that students acquire skills required for their professional development. It is also crucial that the students practise dealing with more demanding patients and learn to communicate better when interacting with members of the healthcare team. Medical education today must therefore *foster* the *development of interpersonal, communication* and *teamwork skills* that are essential for doctors to earn the trust, respect and cooperation of patients and members of the healthcare team.

Recent advances in medical knowledge and the increasing interest in biomedical research has brought about new challenges to the doctor. It is now extremely important for

# Teaching and Learning Legal Writing— A Holistic Approach

**Associate Professor Eleanor Wong**
Faculty of Law
Associate Director, CDTL

The Law Faculty's Legal Analysis, Research and Writing Programme kicked off in the first semester of Academic Year 2002/2003 with a compulsory module, 'Legal Writing 1', for first-year students. One objective which the Deanery had set for my team was to get the 'freshly-out-of-Junior College' students to acquire the habit of thinking and talking (i.e. forming, expressing and challenging ideas). Not only are these skills crucial for future lawyers to make reasoned judgements and communicate them clearly, they are also consistent with our pedagogical philosophy that students only own their knowledge when they are able to articulate it with conviction.

To achieve the Deanery's objective, we had to create an environment where every student would be encouraged to speak up. The four factors taken into consideration were: class structure, classroom dynamics, teaching methodology and assessment design.

## Class Structure—Small Groups

Most law school courses have two basic structures—the lecture-tutorial structure and the seminar structure. The lecture-tutorial structure is usually employed for compulsory, basic courses. With this structure, there would be one or two lectures per week that the entire class (150 to 200 students) attended, and weekly or fortnightly tutorials (10 to 20 students). The seminar structure is typically used for optional, upper-year courses. All students enrolled in the course (anywhere from 20 to 100) would attend the same sessions and the teacher might employ a combination of lecture and interactive teaching methods.

Past students' feedback indicated that they felt more comfortable speaking up in smaller groups. Thus, we decided to conduct all the classes for 'Legal Writing 1' in tutorial groups of 10 to 15 students. The groups met twice a week, for 1.5 hours per session. Only a handful of lectures was organised, most of them optional and conducted by guest speakers. Tutorial sessions were the main forum for learning.

The structure helped foster familiarity and trust among tutorial group members and with their respective tutors. Tutors could conduct their classes at a flexible pace to accommodate the needs of their groups. Also, the small size of each group made it impossible for any student to remain passive.

Our experience has confirmed that this class structure is fundamentally sound in achieving our objective. However, the structure did pose coordination challenges for the teachers, who had to ensure that the entire syllabus content was covered in their individual classes. To address this challenge, in future, we might introduce a few more whole-class lectures to lighten the burden of the individual teachers.

## Class Dynamics—Safe Zones

Feedback from students also revealed that they sometimes remain silent for fear of seeming ignorant. We decided to send a strong signal to students at the beginning of the course that our classes would be 'safe zones' for 'wrong' answers. I also made it a point when selecting the team of teachers (mostly adjuncts and practitioners) that they should believe in, and enjoy teaching with, the Socratic method.

To bring home the point that our classes would be 'safe zones' for discussion, some of us used our first meeting with our students to work out the 'rules of engagement' for these safe zones together. These guidelines covered matters like the level of preparedness expected of each other, civility when disagreeing with each other, and the acceptable process for interrupting a student who has the floor. Participating in the process helped the students see that they were all responsible for creating an optimal in-class environment. They were also happy to observe the guidelines that they themselves had formulated.

## Teaching Methodology—Group Work

We were able to generate good discussions in class with small tutorial groups. Additionally, we constantly built in opportunities for discussions in even smaller groups, often as a preparatory step preceding an in-class presentation, discussion or exercise. We found that this gave each student even more space for expression and complemented the in-class culture of debate.

# This Mirror Had Two Faces

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

When we first met at the lecture theatre at the beginning of the semester, I sensed resistance and tension among the students I was tasked to teach a Property Law module. I found their reticence unsettling. In my years of teaching the module, I had not faced such a difficult 'audience'.

Apparently, they had had a negative first encounter with another Law module the previous year. When queried, the students identified various reasons for their apparent dislike of the subject:

- It was 'so hard'.

- It 'didn't make sense'.

- The way the teacher had taught the module.

- They received poor grades.

I realised that the students seemed to have a *motivation* problem, blaming everyone but themselves. I was determined to overcome these obstacles: I wanted my students to enjoy their learning and be interested in this module. If the students continued to be haunted by their previous experience and I did not address their resistance, there would be losers all round: the students would suffer; I would be dissatisfied. The learning experience I wished for them to have in my module would not be realised.

An uphill task lay ahead for me. But appearing somewhat confident, I said to them, "Well, *this* time round it is going to be different; I assure you, by the time this module is over, you will love the subject". I received sceptical looks in response.

### The Expectancy-Value Theory of Motivation

Research (Biggs, 1999) showed that two factors make students (or anyone) want to learn something:

- It has to be important; it must have some value to the learner.

- It must be possible to do the learning task; the learner has to *expect success*.

In other words, in order to teach *this* lot effectively, it was even *more* critical that I pay attention to setting up an appropriate teaching/learning context. This way, students would have every encouragement to react with the level of cognitive engagement that [my] objectives required (Biggs, 1999).

Several weeks before the start of the semester when I had been preparing my Subject Programme, it had been pretty clear in my mind what my objectives were for the module. Now, I paused to think: What indeed, were *my* objectives for *this* batch of Level 2 Students for *this* module?

I realised that I would have to tweak my earlier proclaimed objectives (by now already printed and issued). These included knowing *what* the law is (Petter, 1982), understanding *why* it is that way, *applying* it to situations before them and within the bigger scheme of things, taking into account the other modules they were taking. Bearing in mind Bloom's taxonomy (Bloom, 1956), I decided that I would pay particular attention to *application*, as this would in turn require 'engagement'. The triggers for such 'engagement' would be the channels I could easily provide, e.g. framing topics for thought and discussion in innovative ways. There were endless forums I could use—during tutorials at scheduled times, during lectures (albeit to a lesser extent), on the IVLE discussion forum, via email, or even in corridors. Hopefully, this would motivate the students to learn.

Thus for example, I would start off discussion on a legal issue in the simplest of terms by asking:

- "Did you read in the papers this morning about the old man who was being asked by some of his children to leave his home? He insisted that although he had no legal title, he had a right to continue living in the house because *he* was the one who paid for it. Would you do that to *your* father?

- "What would you do if your neighbour carried out some major renovation works and as a result caused subsidence (and damage) to your garden and collection of orchids?"

- "Ever see four houses in a row which are all identical in design and painted pink?"

I could make choices on *how* to formulate the issues in a structured manner for elaborate case studies. I could pop questions when the moment seemed right during a

# Project Learning

**Professor Y.K. Ip**
**Department of Biological Sciences**
Associate Director, CDTL

Project learning is organised around the creation, execution and finished production of an experiment, a review, a survey, etc. It is learning with a known focus, expectations of productivity and measurable results. The project usually occurs within a reasonable time frame, ranging from a week to a semester. The nature of the project is dynamic as it goes through conception, configuration, contradiction, confusion, reconfiguration and eventually culmination and celebration (Fogarty, 1997). Project learning is hands-on learning in all its glory.

Project learning is built on the foundation of two constructivist approaches to learning: 'active learning' and 'learning in context'. Active learning refers to the idea that people learn by engaging in a process of sense making which requires the learner's orchestration of a collection of cognitive processes. Besides hands-on activities, successful project learning engages the learner's cognitive processes. Learning in context refers to the idea that each subject discipline requires its own ways of thinking that are best learned from concrete experience on realistic tasks, for example, a project.

In project learning, students take the role of active (in terms of cognition), hands-on learners. They are responsible for the final product. Students may work in teams, with each person responsible for certain tasks. Teachers may take a directive role in some projects and a non-authoritative role in others. Structured projects require a teacher to be directive because the parameters of each project are strictly set. Open-ended projects, in contrast, require a teacher to act as a coach or mentor. Factors to be considered here are the types of project involved, the age of the students, the sophistication of the project, the timelines set and the style of the teacher.

Many activities are required to construct authentic projects in the classroom or laboratory; these activities can be grouped into three stages (see Fogarty, 1997, for details). In the first level of activities, a project is either selected by students from a bank of ideas or defined by the teacher. After the teacher sets the guidelines, the initial stages of reading, researching, interviewing and fact gathering consume the student or student team. This phase of the project engages students in tasks they are most familiar within the school setting (i.e. to use references, find resources and collect data) and lays the groundwork for the inventiveness of the latter two stages. There are a myriad of activities appropriate for this first phase: reading for background information, researching and taking notes, building a reference list, interviewing experts, viewing films and videos, developing an outline, talking with peers, surfing the Internet, checking and double-checking sources, visiting sites, as well as gathering charts, maps and illustrations.

As a project enters the second phase, students become immersed in facts and begin to try to make sense of them. They discover that some information is relevant and some is not. At this level, the students try to analyse whatever information they have, sort the information into meaningful chunks, and synthesise it in order to move the project forward. If a team of students is involved, members must find ways to share their information. A number of activities are often employed in this stage, including: brainstorming ideas, analysing data, charting information, drawing and sketching models, drafting ideas, developing prototypes, filling in missing information, visualising the big picture, reconciling conflicting data, finding a focus, assigning a theme, creating a metaphor, looking for patterns, seeking connections, playing with ideas and finding materials.

At the third phase, the students understand what needs to be done. They divide and prioritise tasks, check timelines, take any necessary emergency measures and stay alert. The activities involved at this stage are model building, construction, assembling, synthesising ideas, rethinking or re-conceptualising, finishing touches, decorative details, evaluative testing, peer review, self-assessment, evaluation against criteria, expert review, final submittals and celebrations.

Project learning not only facilitates active learning in students, but also challenges them to develop higher order thinking skills. It also exemplifies Gardner's theory of multiple intelligences. As Gardner (1983) has suggested, intelligences seldom work in isolation. When learning experiences within a project are considered holistically, it can be seen that different intelligences are exercised and are interrelated with each other. As pointed out by Fogarty & Stoehr (1995), students may use their logical/mathematical intelligence to think through a situation; their visual/spatial intelligence to visualise it; their interpersonal intelligence to empathise with people; their bodily/kinaesthetic intelligence to immerse themselves in a situation through an experiential learning process. In addition, the musical/rhythmic and verbal/linguistic intelligences may come into play as students use music to depict the mood or theme of a problem and discuss, write, listen and read about related issues.

## References

Fogarty, R. & Stoehr, J. (1995). *Integrating Curricula with Multiple Intelligences: Teams, Themes, and Threads*. Arlington Heights, Ill.: IRI/SkyLight Training & Publishing.

Fogarty, R. (1997). *Problem-based Learning and Other Curriculum Models for the Multiple Intelligences Classroom*. Arlington Heights, Ill.: IRI/SkyLight Training & Publishing.

Gardner, H. (1983). *Frames of Mind: The Theory of Multiple Intelligence*. New York: Basic Books. ■

# To Each His Own

**Ms Chew Moh Leen**
Lecturer, Centre for English Language Communication

To each his own, people always say; one student would gleefully jump into any group activity while another would drag his feet to join one. As an English language teacher in the Science Faculty, I constantly witness that not every student is enthusiastic about the same classroom tasks. For me to design activities that cater to my students' classroom needs effectively, I must know their learning style preferences (Kinsella, 1995; Reid, 1995). Additionally, when students understand their personal learning style preferences, they can exploit their strengths and compensate for their weaknesses in any learning situation (Gardner & Jewler, 2000).

In my search for a tool to assess students' learning style preferences, Joy Reid's (1995, p. 202) Perceptual Learning Style Preference Questionnaire stood out as the perfect device for my purpose because it discusses four sensory learning styles, visual, auditory, tactile, and kinesthetic, and two social learning styles, individual and group, in relation to learning English. These learning styles are defined as follows:

- *Visual Learners* like *to see* words/pictures and often work alone before discussion with others.

- *Auditory Learners* like *to hear* the spoken word through debates, individual conferences and small group discussions.

- *Tactile Learners* like *to touch* and prefer hands-on activities (e.g. building models, doing laboratory experiments).

- *Kinesthetic Learners* like *experiential learning,* and prefer physical activities (e.g. field trips, role-play, drama).

- *Individual Learners* like to *work alone* and prefer self-directed study, independent reading and computer work.

- *Group Learners* like *group interaction*, and prefer social activities (e.g. games, role-play).

## The Assessment of Learning Styles

384 Joy Reid's Perceptual Learning Style Preference Questionnaire forms, collected from 1996 to 2001, were used for this assessment. The questionnaire categorises Science students as having major, minor and negligible learning styles in their study of English. Curious to know whether students perceive themselves as using the same learning styles to study their content subjects, I posed this question to them: "Do you use different styles/strategies when studying subjects other than English?"

## The Results and Interpretations

- *Preference Mean*: The chart shows that NUS Science students are major kinesthetic learners, and are close to being major visual, auditory, tactile, group and individual learners. Perhaps Science students favour such learning modes because they have to sit in lectures and tutorials to view (visual) what is on the screen/white-board, listen (auditory) to lecturers/tutors expound subject matters, move about/be involved (kinesthetic) in group work, and use their hands (tactile) to do projects and laboratory experiments. All this could predispose them to adopting the same learning styles when learning English.

Table 1: Learning Style Preference Mean of Science Students



Legend: Mean = 0-24 Negligible style preference; Mean = 25-37 Minor style preference; Mean = 38-50 Major style preference
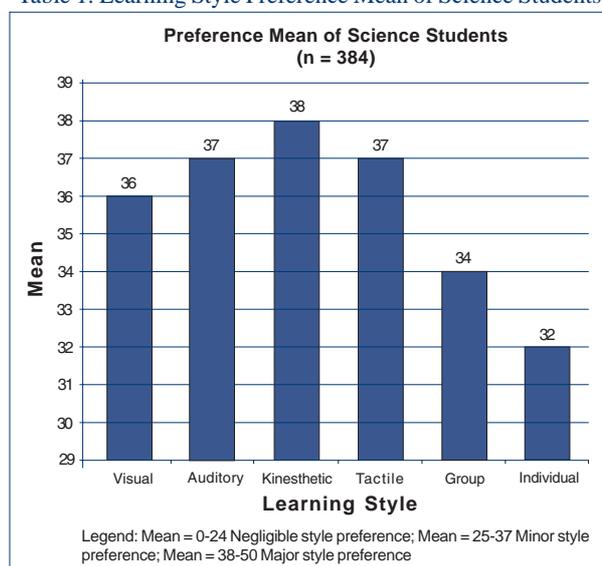
If such reasoning holds, then what students indicated as their learning styles in studying English should correspond to those they use in studying other subjects. Therefore, I expected most students to say "No" to the use of different styles/strategies to studying subjects other than English. However, this is not so according to the following data.

- *Do Students Change Their Preferred Styles/Strategies?*: The table below shows that more students (43%) claimed they change their learning styles when they

study different subjects, compared to 25% who do not and to 32% who could not decide. So does the first percentage mean that students actually change their learning styles? Or are they just extending their minor learning styles to exploit their learning experience?

Table 2

| Responses to the use of different styles/strategies when studying subjects other than English (n = 264) | |
| --- | --- |
| Yes | 43% |
| No | 25% |
| Not sure | 32% |

To resolve these questions, let us consider the learning experience of one of my students. He explained that whenever he had to engage in group work during class, he would get nervous and stutter. I noticed the stuttering; however, I assured him that it did not hamper his communication. He asserted that he did not enjoy group activities because they intensified his fear of making mistakes in public; thus he would stutter even more. Finally, he concluded that it was his fault and he did not expect me to change my teaching style.

Evidently, this student was put in situations where he had to adapt his learning styles to accommodate my teaching style. If I subscribe to what Kinsella (1995) and Oxford (1995) reported that learning styles are people's natural and preferred way of absorbing and retaining new information which persist across teaching methods and content area, then this student was just tolerating the situations he was in without intending to use group style/strategy again.

I reckon that those students who stated that they change their learning style/strategies when studying different subjects share the same learning experience as this student—their change of learning styles was merely perceived rather than real because they must fit into the flow of each class (each is different arising from the different nature of each subject) to learn even though their learning styles do not match their teachers' teaching styles. Those who were uncertain about whether they change their learning style/strategies when studying different subjects also concurred that they conform to their teachers' teaching styles in class, and that was why they could not decide whether they really change their learning styles/strategies in studying different subjects.

## Implications for the Teacher

The findings reveal that:

- Science students are predominantly kinesthetic learners and are nearly major visual, auditory, tactile, group and individual learners;

- Students' preferred ways of learning do not change regardless of content and teaching methods; and

- Students accommodate their teachers' teaching style in order to learn.

The findings confirm that if I want to significantly enhance student achievements in class, I need to match my teaching style to my students' learning styles (Felder & Henriques, 1995; Grasha, 1996). This implies that I have to embrace a multi-style teaching approach to connect to each student's learning style by designing interactive activities to maximise kinesthetic students' learning potential, and by planning auditory, tactile, visual, group and individual activities to reach other students. The results also tell me that I have to encourage students to expand their learning styles in their study of English and content subjects as each teacher has his/her teaching style which is difficult to change.

## Strategies for the Teacher

Hence, my next concern was how to help students use their preferred learning styles to learn best.

- *Helping Students in Studying All Subjects*: In studying all subjects, I suggested concrete strategies for students to use and urged them to practise and develop them in creative ways. Lecture/tutorial strategies include preparing tutorial answers with a partner/partners beforehand (group learners), visualising what they are listening to (visual learners) and recording lectures (auditory learners). Study time strategies include reciting information aloud (auditory learners) and getting together with others to discuss assignments (kinesthetic/group learners). Each learner was encouraged to find that works best for him/her and to try out their less preferred strategies in all their learning circumstances.

- *Helping Students in Studying English in Class*: In my classroom teaching, I try to organise tactics to reach each student's learning needs. For example, in a lesson on idioms, I made each student draw a card that contained either a picture or an idiom; then the students had to look for their matching idiom/picture. When they found their correct match, they gathered in groups to role-play a story based on the idioms they had. This activity benefited the kinesthetic, tactile and group learners as they were required to move about, write, and discuss in groups. It also benefited the visual, auditory and individual learners as they had to listen and read text/see pictures.

  In another attempt to stimulate students to capitalise on their learning styles, I placed a toy dinosaur that could walk on my desk just before a listening and speaking lesson on why dinosaurs are extinct. This was to motivate the visual and individual learners to think prior to the lesson. Kinesthetic, tactile and group learners had to expand their learning styles by seeing and hearing the lesson.

## A Final Note

Since knowing that students learn in various styles, I have begun to adopt a multi-style teaching approach in class to enhance students' learning. I do not stick to my desired style of teaching anymore; I have to constantly adapt and

# CDTL Library

The **CDTL library** houses a small but comprehensive collection of books and resources on educational development, effective teaching, learning, evaluation and testing, educational technology and other important aspects of teaching and research in education. You can search for these books and other resources by title, author, call number and subject online at *http://www.cdtl.nus.edu.sg/library/* and come to the **CDTL library** to borrow the books.

The following monograph series (research surveys, papers and reports) conducted or written by former CDTL staff members will soon be available for browsing at the **CDTL library**:

William Koh. (2000). *Executive Summary of the Employers' Survey.*

Chee Yam San. (2000). *NUSCast Survey: Instructor Perspective.*

C.M. Wang, Chandrama Acharya & Glen O'Grady. (2001). *Construction and Evaluation of Teaching Portfolio.*

Chandrama Acharya. (2003). *NUSCast Survey: Student Perspective.* ■

## Goodbye!

CDTL has experienced some staff changes in the past few months. We would like to thank Ms Chandrama Archarya, Research Assistant, who left us in June 2003.

## Welcome!

At the same time, we welcome Mr Emil Cheong Shen-Li, who joined us as Research Assistant in June 2003. ■

## New articles for Successful Learning Series!

**successful** learning is a series of short articles containing practical tips to help students improve how they learn.

A new batch of 34 articles, written recently by NUS teaching staff, has been added to the existing series. NUS staff and students may view these articles soon via *http://www.cdtl.nus.edu.sg/success/*. ■

## Calling All Writers...

CDTL invites articles on any teaching and learning topic for the following two newsletters:
- **CDTLink** (700 words maximum per article; photos & illustrations in hard/digital copy are welcomed)
- **CDTL Brief** (text-only newsletter; 1000 words maximum per article)

To submit articles for consideration or to obtain more informartion, please contact: **Ms Teo Siok Tuan**
Email: sioktuan@nus.edu.sg
Tel: (65)-6874 4692 • Fax: (65)-6777 0342 ■

# Emerging Trends in **ICT** in **Engineering** and **Computing Education**

*Exploring where teaching, learning and technology meet. Examples of how information and communication technology (ICT) is being applied to support a contemporary focus on student-centred learning in engineering and computing education.*

| Date | : | Saturday, 2 August 2003 |
|---|---|---|
| Time | : | 9.00am–1.00pm |
| Venue | : | Engineering Auditorium, Block EA |

## Symposium Preview

### International Guest Speaker

**Dr. César A. Núñez-López**

*Research Chair on Engineering Education Research & Innovation
Director, Mechatronics Engineering Program,
Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM) Campus Monterrey, Mexico*

Dr. Núñez-López received his PhD from the University of Manchester Institute of Science and Technology (UMIST) in the UK and has been conducting research in materials engineering and in engineering education. A member of the Mexican National System of Researchers, he received the Innovation in Education Award, ITESM System in 1998. His current research in engineering education includes the development of a model for engineering education which maximises learning while considering faculty and administration constrains, and the development of a 'Virtual Manufacturing Plant' for engineering education using PBL as core didactic instructional technique

Dr. Núñez-López  will present his experience in the integration of ICT into the ITESM engineering curriculum and outline his research efforts in developing a remodelled approach to engineering education that takes into account the use of contemporary learning strategies, ITC's tools, learning activity resources (e.g. laboratories) and learning technologies like simulators and virtual environments. ITESM's attempt to maximise the benefits of ICT in supporting the teaching and learning process, while minimising the inherent drawbacks, highlights fundamental issues that computer science educators also need to consider.

### Guest Speaker

**Dr W.A.M. Alwis**

*Director of Academic Affairs, Republic Polytechnic*
Dr Alwis will present his experience in using ICT in engineering and computing education.

### Speakers

**Dr Anjam Kursheed**

*Associate Professor,
Department of Electrical & Computer Engineering, Faculty of Engineering*

Associate Professor Kursheed will present his experience in making his science demonstrations available to his faculty colleagues through the 'NUS Learning Objects Repository' feature in the IVLE Content Management section.

**Dr Rajagopalan Srinivasan**

*Assistant Professor,
Department of Chemical & Environmental Engineering, Faculty of Engineering*

Dr Srinivasan will present his experience in creating an outline process dynamics and control simulation which aims to assist students in linking classroom theory to its related application in industrial practice.

**Mr J.A. Gilles Doiron**

*Principal Educational Technologist, Centre for Development of Teaching & Learning*

Mr Doiron will present his experience in designing an online peer learning model which aims to have sudents review their peers' answers to open-ended questions as a learning activity to widen their perspectives and initiate meaningful debate.

In addition there will be a panel discussion on 'Reusable Learning Objects'.

**Registration:**

The Symposium is tailored for the academic staff of the Faculty of Engineering and the School of Computing. Interested parties from other faculties are welcome to attend. Registration will however, depend on space availability. For more information, visit *http://www.cdtl.nus.edu.sg/conferences/ict/* or contact **Gilles Doiron** at **6874-2529,** email: doiron@nus.edu.sg

*Jointly organised by Faculty of Engineering, School of Computing and Centre for Development of Teaching and Learning.* ■

# TEACHING & LEARNING
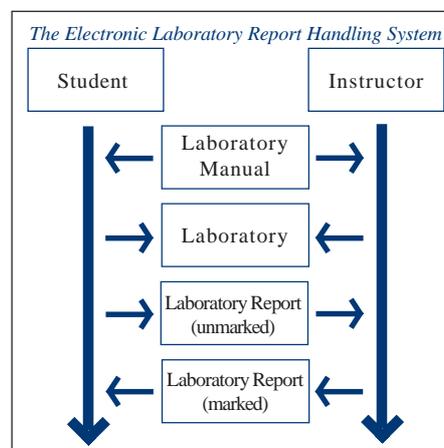## highlights

### Faculty of Engineering
**Electronic Laboratory Report Handling**

Physical laboratories sessions are indispensable in engineering education. After every laboratory session, students are expected to prepare written or printed reports. Handling paper reports is troublesome and problematic: reports can be unaccounted for and notifying students (especially non-campus bound students) to collect graded reports can be difficult.

An electronic laboratory report handling system, done as an online/distance education research group project (*http://btech.eng.nus.edu.sg/Course/ DistanceEducation/DistanceEducationProject02.html*), is expected to overcome these impediments. Students and instructors can download the laboratory manual from the web-based server before the laboratory session. Each student then prepares an electronic report according to instructions and uploads it to the web-based server for the instructor to download and grade electronically (*http://www.cdtl.nus.edu.sg/ link/Mar2002/tech2.htm*) after the laboratory session. The instructor then uploads the graded report to the web-based server for the student to retrieve for reference. If a report is improperly done, the instructor can notify the student to resubmit the report for another round of grading. This system was experimented over a period of three semesters and received positive responses from instructors and students. ■

*The Electronic Laboratory Report Handling System*

| Student | | Instructor |
|---|---|---|
| | Laboratory Manual | |
| | Laboratory | |
| | Laboratory Report (unmarked) | |
| | Laboratory Report (marked) | |

### Faculty of Law
**An Innovative Service-learning Project—'Sex, Rights & Videotape'**

In an innovative service-learning project, five NUS law students produced a radio programme titled 'Sex, Rights & Videotape' which aired on NewsRadio 93.8 from 9 February to 17 March 2003. Through the production of the six-episode series, the students informed and engaged the general public in discussions on legal issues challenging the balance between individual rights and social interests. While doing so, students learned how to communicate and apply their legal knowledge in settings where the people with whom they interacted were not all legally trained. In addition, students practised their legal skills as they researched, analysed and devised interview techniques. By interviewing people and designing an informal online poll to get the views of legal experts, academics, opinion leaders and laypersons, students also sharpened their communication skills. In the process of producing the programme, students gained insight into the social, political and cultural contexts of the legal issues they were exploring and learned how to work together as a team—a valuable experience for legal practice. ■


*The radio team. Back L to R: Sonita Jeyapathy & Amarjit Kaur. Front L to R: Shivani Retnam & Lynette Chua*

### Faculty of Science
**Visualisation in Mathematics: Value-Added Lectures**

As a member of his department's teaching committee, A/Prof Helmer Aslaksen has observed that many lecturers who just read aloud from their notes during lectures. This raises the question: What's the point of attending such lectures? Can we instead just cancel lectures and ask the students to read notes on the web or watch webcasts? A/Prof Aslaksen believes that lecturers should add value by giving the students something they cannot get from the notes to make it worthwhile for the students to attend lectures.

In his lectures for both GEM1506K 'Heavenly Mathematics: Cultural Astronomy' and GEM1518K 'Mathematics in Art and Architecture', A/Prof Aslaksen relies heavily on visualisations. He involves his students in acting out the motion of the planets and uses props like a polar bear and a tiger to demonstrate the difference between what the sky looks like to observers at the North Pole and the equator. ■


*Props used for visualisations in GEM1506K*

*Figure 1: One of the research projects on e-Measurement by QS-Core research team*

## School of Design and Environment
### e-Measurement

The Department of Building strives continuously to introduce new technology in teaching of our students. Advances in technology have helped quantity-surveying students move away from labour intensive tasks (e.g. manual processing of quantities of items of building works) to concentrate more on the important aspects of non-traditional quantity surveying services.

Set up in July 2002, the Department's state-of-the-art e-Studio has the latest technology to instruct students on how to carry out online measurements, thus preparing them to be 21st Century Quantity Surveyors. Not only are our students required to keep pace with the latest technology, they also have to look beyond the promise of the current technologies by exploring and harvesting the benefits of new knowledge.

In conjunction with established construction players, the QS-Core-Leader initiated two research projects on e-Measurement to encourage students to do a variety of diverse collaborative activities through formalised structures in the e-Studio. ■

### Teaching and Learning at the University of California, Berkeley: A Faculty Seminar

In Semester 1 (Academic Year 2002/03), Dr Florence Ling Yean Yng from the Department of Building spent a few months at the University of California, Berkeley (UCB) as a visiting scholar. At UCB, Dr Ling attended lectures for final year undergraduates, graduates and gave lectures to graduates and PhD students at the Engineering and Project Management Unit at the Department of Civil and Environmental Engineering.

Dr Ling led a faculty seminar in February 2003 to share her UCB experiences with her NUS colleagues. Mr Terence Tan, an NUS 3rd year BSc (Building) student, who spent one semester in UCB on the Student Exchange Programme was invited to the seminar to enable the faculty to have a more complete picture. Some of Dr Ling's observations in UCB include:



*Dr Florence Ling Yean Yng at University of California, Berkeley*

- Tutorials are non-existent but it does not seem to affect the students.

- Like lecturers in NUS, the professors deliver their lectures in front of the class using overhead projectors and transparencies. The professors do not over-teach and students are expected to do background reading.

- Many professors adopt interactive teaching methods to get timely and useful feedback from students.

- For continuous assessments, students have a large number of tests, homework and projects that may account for 50–100% of overall assessment. Graduate Student Instructors help professors grade the continuous and final assessments.

- Students are motivated, energetic and intelligent. Apart from studying, students do part time jobs and administrative work within the university. ■

## Faculty of Medicine
### Faculty of Medicine Becomes a Founder Partner of the International Virtual Medical School

The Faculty of Medicine, NUS, recently became a founder and partner institution of the International Virtual Medical School (IVIMEDS), based in Dundee, Scotland. IVIMEDS partners are an international network of medical schools and professional organisations and institutions that are involved with the education of healthcare professionals through the application of new educational learning technologies. IVIMEDS seeks to play a role in improving health and tackling human disease world-wide by providing a blend of e-Learning and high quality face-to-face learning for health care professionals. The IVIMEDS network will develop and implement new approaches to curriculum planning and advanced instructional design incorporating the use of curriculum maps, outcome-based education, electronic study guides, peer-to-peer learning, dynamic learning and a bank of reusable learning objects. ■

*University Scholars Programme*
**Opening of the University Scholars Programme Writing Centre**


*The Centre's writing assistants*


*A conference in progress*

The University Scholars Programme Writing Centre (*http://www.scholars.nus.edu.sg/writingcentre/index.html*) opened in January 2003 with Dr Julia Gardner as its current director. Following the models of established writing centres at leading universities such as Harvard, Cornell and Princeton, the Writing Centre offers one-to-one peer-facilitated conferences to help students negotiate the writing/thinking process (e.g. brainstorming, developing a thesis, structuring an argument and revising a draft). Student Writing Assistants receive extensive training to teach students general writing strategies in the context of specific assignments and to help them become astute readers of their own writing.

The Writing Centre also supports Scholars Programme faculty members who would like to confer with a colleague from the Writing and Critical Thinking Domain regarding incorporating or supporting ideas for writing in their modules. In the longer term, the Writing Centre hopes to archive sample assignments and essays from various disciplines offered at the Scholars Programme so faculty members could review successful assignments as they develop their syllabi and facilitate the exchange of ideas across disciplines. ■

## Teaching and Learning Legal Writing—A Holistic Approach

A research assignment involving group work, conducted over three weeks, was particularly successful. Its principal objective was for students to learn how to carry out legal research. A fact pattern was assigned to the students to analyse and identify the potential legal claims that their 'client' might be able to sue for or defend. They then had to research the law (in an area they had not studied) and advise on the client's likelihood of success in a legal proceeding.

Each tutorial group was divided into three teams comprising three to four students. At each class, two of the teams would present their findings and recommendations, while the third team played the role of the 'managing partner', testing and evaluating their classmates' competing recommendations, and deciding the next step to take. The teacher's role was to guide the students by breaking down the research process into 'bite-sized chunks', progressively introducing the students to different sources for finding the relevant law (from general sources such as textbooks to specific cases). The exercises culminated in final presentations by each team.

Our uniform experience was that the students out-performed our expectations in this series of exercises. Our observations include:

a) Some of us videotaped the 'practice' presentations and put them online for students to review and comment on. Students improved their presentation skills substantially both from viewing themselves and from the comments of their classmates.

b) Teams that role-played managing partners took their job seriously and quizzed their classmates rigorously.

Some students seemed more challenged by the prospect of presenting to their classmates than to their teachers and prepared more thoroughly!

c) Teams sometimes stayed back to quiz each other further in an effort to reconcile different research findings or differing interpretations of such findings. Many of these informal discussions yielded valuable insights without any need for the instructor's input.

d) From the practice presentations to the final presentation, students showed exponential improvements in their confidence, clarity and grasp of the law.

e) Many teams demonstrated teamwork and sensitivity, purposely giving their quieter and less confident teammates opportunities to shine.

### Assessment Design—Class Participation

The final component of our holistic approach was assessment design. Class participation accounted for a large proportion of the grade, giving students a strong incentive to participate.

There is still much to learn. Specifically, we can improve on balancing common classes with individual classes, and we can craft better exercises to encourage different kinds of participation and different modes of expression. However, as an initial attempt at generating a culture of analysis and expression, our experience has seen modest success. We are excited about trying again in Academic Year 2003/2004. ■

# Good Teaching: Whose Point *of* View?

**Associate Professor Grace Ong**
Vice-Dean, Faculty of Dentistry

What is good teaching? Many academics in reflective moments have asked themselves this question. Administrators in institutions of learning struggle with this question as they attempt to meet students' needs and create reward schemes for their teaching staff. But the answer is elusive, one possibility being: "It depends." But who is asking the question in the first place: the student, the teacher, or the administrator?

From reviewing past students' feedback over the last few years, I would like to share some of their perceptions of what makes good teaching. The students' qualitative feedback can be broadly categorised into two groups, A and B.

Let's look at the teacher's perception of these two broad categories. Some will look at Group A and conclude that this is good teaching. But is this really what a teacher would like see in his feedback?

| Group A | Group B |
|---|---|
| • Communicates clearly | • Interests me to read further |
| • Explains difficult concepts well | • Probes us |
| • Is approachable | • Makes us think laterally |
| • Is knowledgeable | • Makes us question concepts |
| • Is willing to listen | • Willing to listen to another point of view |
| • Prepares us for the examinations | • Has a different approach to teaching |
| • Helps us problem-solve | |
| • Always there when we need him/her | *(NB: Elements from Group A are also often included in this category.)* |

What about Group B? It would seem that teachers in this group are not only are good, but also effective teachers, able to enthuse their students, stretch them and make them think. However, can all administrators see the difference between Groups A and B?

Consequently, both teachers and administrators must address the issue of good teaching vs. effective teaching. If we simplify the equation such that effective teaching = good teaching, could we also say that good teaching = effective teaching?

Students seem to have a problem differentiating good teaching from effective teaching. In looking at nominations for good teachers, the majority of students nominate teachers in Group A as good teachers, and only the discerning few would nominate Group B teachers. Teachers in Group A often are very good at mentoring students and meeting their emotional needs. After studying student feedback, I have come to the conclusion that students have great difficulty differentiating a good mentor from an effective teacher. In fact, many see the mentor as their ally and the effective teacher as the aggressor.

Thus, it is important for administrators to get the right message across: does the administration require effective teaching or only good teaching? Unfortunately, in this less than perfect world, reward schemes play a significant role in modelling behaviour. Thus, setting the right criteria for teaching standards is important.

While reflecting on teaching, we should consider another point: is bad teaching really detrimental? After all, what does bad teaching do? It often drives learners to the library. The outcome: independent learners. Isn't this one of the outcomes of effective teaching?

So, what are the expectations of teaching?

• Whose expectations are to be met: the students, the teachers, or the administrators?

• Is there a match among these groups?

• Who is right?

• Does it matter if there is no match?

I would like to share some personal thoughts: What happens if there is no match in expectations? Each individual teacher should then ask himself/herself these questions:

• What is my goal?

• What am I trying to achieve?

• What outcomes do I expect?

Having answered the above honestly, each teacher should develop a strategy so that all parties concerned are aware of the individual teacher's goals and expectations. When the various parties concerned are aware of your own expectations, they will understand your actions better and misperceptions can be avoided. Therefore:

• Make your goals known to both administrators and students.

• Negotiate and draw contracts between parties concerned.

So… Good teaching: Whose point of view? Your point of view matters most. ■

## Medical Education: Enhancing Learning in the Affective (Feeling) Domain

doctors to have a good working knowledge of medical **ethics** as well, so that the patients' rights can be protected and their safety ensured in the clinical setting.

### Conclusion

In the educational preparation of today's medical students to become *competent and caring doctors* of tomorrow, the quality of medical education that we provide needs to ensure that the end-products (graduates) of our education acquire not only the desired knowledge and psychomotor skills required of a technically competent practitioner, but also the desired attitudes and mindsets to learning. In addition, our graduates are expected to show a more caring attitude in their patient management and interaction with members of the healthcare team. For this reason, enhancing learning is the affective (feeling)—yet another testimony to our continued quest in promoting professionalism and excellence in medical education in our medical school domain, is now a significant feature of our recently revised undergraduate medical curriculum.

### References

Bohuijs, P.A.J. (1998). 'The Teacher and Self-directed Learners' in *Medical Education in the Millennium*, Jolly, B. & Rees, L. (Ed.). New York: Oxford University Press. pp. 192–198.

General Medical Council, U.K., (1993): *Tomorrow's Doctors: Recommendations on Undergraduate Medical Education*. *(http://www.gmc-uk.org/med_ed/tomdoc.htm)*. (Last Accessed: 29 April 2003).

Woosley, R.L. (1997). 'Foreword' in *Integrated Pharmacology*. Page C.P. *et al*. (Ed.). London: Mosby. pp iii.

'*Communication*' in *Alumni Newsletter*. May 2001, pp. 1. ∎

## This Mirror Had Two Faces

discussion as an add-on to what a student had already contributed in class. I could even *end* a class by raising issues to provide students with food for thought after the class. These were just some of the ways I tried to *engage* students: by getting them to think about real-life problems and *then only* drawing them back to the legal issues and principles which would determine how a dispute may be settled.

### So How Did I Do?

Quite honestly, I don't know—at the time of writing this article, the Student Feedback Evaluations were not yet available. However, there has been much evidence through various forms of informal communication and feedback that the students have changed their mind about Law: '*challenging*', '*stimulating*', '*thought-provoking*' and even '*enjoyable*' were some of the words students had used. From my point of view, I was satisfied—I believe I had them 'hooked' and hopefully, this would contribute in some way to their life-long learning. I was happiest when I received students' email messages such as this: "Ma'am, the other day while I was riding in the bus on the way home, I spotted a residential development with a shared but damaged carpark. I thought about we had discussed in class that morning and went home and read up more about it."

I could now appreciate more deeply what Shuell (1986) meant when he wrote:

> If students are to learn desired outcomes in a reasonably effective manner, then the teacher's fundamental task is to get students to engage in learning activities that are likely to result in their achieving those outcomes; it is helpful to remember that what the student does is actually more important in determining what is learned than what the teacher does.

### References

Biggs, John. (1999). *Teaching for Quality Learning at University: What the Student Does*. Buckingham: Society for Research into Higher Education and Open University Press.

Petter, A. (1982). 'A Closet within a House: Learning Objectives and the Law School Curriculum', Chapter 5 in A. Petter, *Essays in Legal Education*. Butterworths, Ontario, Canada.

Bloom, B.S. (1956). *Taxonomy of Educational Objectives, Handbook I: Cognitive Domain*. Longman: London.

Shuell, T.J. (1986). 'Cognitive Conceptions of Learning', *Review of Education Research*, Vol. 56, pp. 411–36. As cited in Biggs, John. (1999). *Teaching for quality learning at university: What the student does*. Buckingham: Society for Research into Higher Education and Open University Press. ∎

## To Each His Own

develop classroom tasks so as to cater to each student's different learning needs, eventually satisfying to each his own.

### References

Felder, R.M. & Henriques, E.R. (1995). 'Learning and Teaching Styles in Foreign and Second Language Education'. *Foreign Language Annals*, Vol. 28, No. 1, pp. 21–31.

Gardner, John N. & Jewler, A. Jerome. (2000). *Your College Experience: Strategies for Success* (4th ed.). Belmont, California: Wadsworth Publishing Company.

Grasha, A.F. (1996). *Teaching with Style: A Practical Guide to Enhancing Learning by Understanding Teaching and Learning Styles*. Alliance Publishers, International Alliance of Teacher Scholars, Inc.

Kinsella, K. (1995). 'Understanding and Empowering Diverse Learners in ESL Classrooms'. In J.M.Reid (Ed.), *Learning Styles in the ESL/EFL Classroom*. Boston: Heinle & Heinle. pp. 170–195.

Oxford, R.L. (1995). 'Gender Differences in Language Learning Styles: What Do They Mean?' In J.M. Reid (Ed.), *Learning styles in the ESL/EFL classroom*, Boston: Heinle & Heinle. pp. 34–46.

Reid, J.M. (Ed.). (1995). *Learning Styles in the ESL/EFL Classroom*. Boston: Heinle & Heinle. ∎

# Creating an Effective Learning Environment: A Student-centred Approach
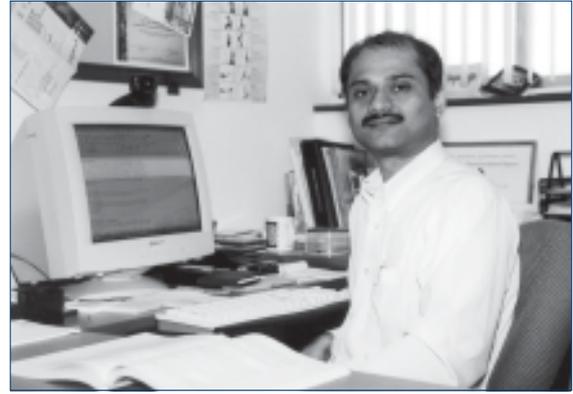
**Assistant Professor Ashwin M. Khambadkone**
Department of Electrical & Computer Engineering

As lecturers, we hope to inspire students to learn with the joy of learning. However, we are often confronted with the students' lack of motivation to achieve various learning objectives.

With reference to Maslow's Hierarchy of Needs, Root[1] claims that once an individual's basic levels of physical and social needs are satisfied, growth in learning results from internal motivating factors. While deep learning happens when a person's basic needs are met, 'fear of failure' is often the cause of shallow learning. Creating a learning environment with clear learning objectives and carefully planned assessments matching the objectives can help the learner feel more secure.

Assessments are both formative and summative. When used effectively, assessments can encourage self-directed and in-depth learning.[2] However, assessments alone will not achieve deep learning. Creating an effective learning environment includes looking into many other factors that I shall highlight in this article.

The basis of student-centred learning method is to empower students towards learning on their own with the help of clear and easily accessible learning objectives. Rogers'[3] approach to therapy as a learning process is based on the following hypotheses about learning:

1. We cannot teach another person directly but only facilitate their learning.

2. A person learns significantly when there is enhancement or maintenance of the structure of self. However, any learning that is a threat to the structure of self will be resisted or distorted. Hence, an effective learning environment should minimise threats to the learner and allow differentiated perception of the field of study. An undifferentiated perception, according to Rogers, is when an individual accepts an idea that he has heard or read about (e.g. rituals, superstitions) absolutely and unconditionally, without verifying it against practical experience and evaluating it with respect to the situation. In addition, the person is also unaware of multiple levels of abstraction associated with the idea, confuses fact and evaluation, and relies on the idea rather than real experience.

As opposed to the traditional subject-based approach[4] where modules are designed by identifying the important content and looking into ways of transmitting the content to the student, instructional system design is a client or student based approach that follows a process similar to engineering design (See Figures 1 and 2 next page).

In designing/re-designing modules, one should start by looking at the input conditions, what the learner knows and the desired outcomes. Outcomes and objectives can be classified into three components:

1. **Knowledge**

   In the traditional approach, the focus would be on the body of knowledge, whereas the student-centred approach focuses on the processing of knowledge. Knowledge refers not only to what the students know, but also how well the student applies the knowledge to a broader spectrum of problems or situations.

2. **Skills**

   Skills that are expected from the learner must be identified and stated (e.g. the application of a particular method of experimentation or use of specific computer software could be skills that one expects from the learner).

3. **Attitudes**

   Learning attitudes (e.g. independent problem solving, group activity, creative thinking) also need to be identified and stated.

In addition, learning methodology and assessment must be designed to complement each other. Assessments should match the learning objectives and provide feedback to the learner. Criterion-referenced assessment[5] can help promote in-depth learning.
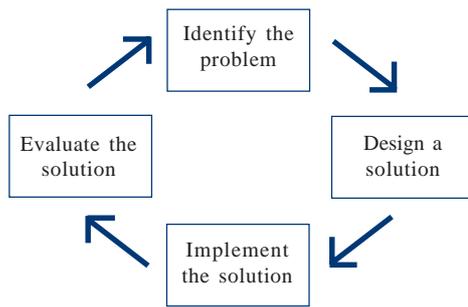
Last but not least, to close the loop effectively, whether learning has successfully taken place should be evaluated via student feedback on subject learning and workload. A student feedback form, consisting of selected questions from a question bank that are useful for evaluating the subject, learning, attitudes or specific learning objectives, could be provided. Lecturers may choose the relevant

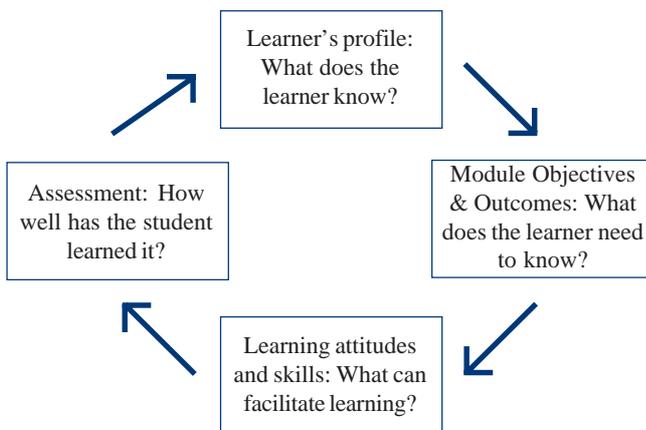## Creating an Effective Learning Environment: A Student-centred Approach

Figure 1: Engineering Design

```
        Identify the
          problem
    ↗                  ↘
Evaluate the        Design a
  solution          solution
    ↖                  ↙
        Implement
        the solution
```

*This cycle repeats itself thus making the process dynamic, flexible and creative. The solution that is designed needs to be effective and efficient. Thus it has to achieve its objective without incurring high costs.*

Figure 2: Instructional Systems Design

```
        Learner's profile:
        What does the
        learner know?
    ↗                        ↘
Assessment: How         Module Objectives
well has the student    & Outcomes: What
learned it?            does the learner need
                            to know?
    ↖                        ↙
        Learning attitudes
        and skills: What can
        facilitate learning?
```

questions required to evaluate a particular objective that he or she wishes to assess. While lecturers can use student feedback to evaluate whether specific learning objectives of a particular module has been achieved, accreditation bodies such as Accreditation Board for Engineering and Technology (see *http://www.abet.org/criteria.html*, Criteria 2 and 3) in turn evaluate the success and quality of entire educational programme by assessing the closed loop process.

To summarise, an effective teaching and learning environment can be implemented using a systematic approach to module design. As the core principle behind systematic module design is student centred learning, the focus is on empowering students to achieve self-directed learning. A systematically designed module allows lecturers to estimate the students' present level of understanding, and then appreciate and respond to those needs. As a result, the design of teaching and learning is a cycle complete with continuous feedback from students. Instead of using a particular teaching strategy in a module, the more student centred solution may be to apply a unique mixture of different learning strategies depending on the circumstance. In other words, it is more important to facilitate learning than to forcefully implement a particular strategy.

### Endnotes

1. Root, A A. (March 1970). 'What Instructors Say to Students Makes a Difference'. *Engineering Education.* Vol. 60, No. 6, pp. 722–725.

2a. Khambadkone, A.M. (2002). 'Assessment towards in-depth and student centered learning' In Aung, W. (Ed.) et al., *Engineering Education and Research-2001: A Chronicle of Worldwide Innovations.* New York: Begell House Pub. pp. 79–86.

2b. Khambadkone, A.M. (2002) 'Creating a Self Directed Learning Environment: Module Design and Implementation'. Abstract from International Conference on Engineering Education 2002. Manchester: University of Manchester Institute of Science and Technology. *http://induce.cc.umist.ac.uk/icee2002/programme/paperdetails.asp?paper_ID=249* (Accessed: 3 January 2003).

3. Rogers C. (1951). *Client-Centered Therapy.* Boston: Houghton-Mifflin.

4. Johnson, Kerry A. & Foa Lin J. (Eds). (1989). *Instructional Design, New Alternatives for Effective Education and Training.* New York: Macmillan.

5. Khambadkone. op. cit.

### Reference

Pan, Daphne. (2001). *Learning to Teach, Teaching to Learn: A Handbook for NUS Teachers.* Centre of Development of Teaching and Learning, Singapore: National University of Singapore. ∎