

## For engaging and motivating Engineering students to induce deep learning and understanding through contextual and multisensory teaching and learning approaches

### OVERVIEW:

I joined James Cook University in 2009 and I have been passionately involved with teaching CS2001: Engineering Strength of Materials, CS2003: Introduction to Structural Design, CS3001: Concrete Engineering and CS3004: Transportation Engineering. My teaching philosophy reflects my interest in creating a student-centred, active teaching and learning environment that encourages learning and interaction of both students and teacher. I strongly believe that in tertiary education, especially in engineering, the role of an instructor is not only to equip students with the fundamental theories but also to instil critical thinking and problem-solving skills. My teaching and work experiences in world renowned universities have helped me to develop course structures and materials to include course-relevant state-of-the-art developments. I have also effectively integrated my research and industrial experience into my teaching. I facilitate students to conduct collaborative projects with industries and regularly invite professionals from local industries into the classroom to deliver lectures. My teaching practice has been very successful in generating a high level of motivation, long-term retention of knowledge in students and outstanding student outcomes.

Aligned with the JCU's vision of providing sustainable development education, I have proactively refreshed CS3001: Concrete Engineering curriculum to embed sustainable development concepts into the course. The course refreshment was carried out after in-depth consultation with both internal and external sustainability experts and involved program wide mapping of learning pathways. Additionally, I have developed and refreshed a comprehensive set of resources for CS3001, CS2003 and CS3004. The lecture notes have high quality visual illustrations and practical examples to facilitate students to understand core concepts and particularly to relate to real-world problems. The scaffolding of lectures, assignments, practicals and tutorials in my subjects follow a holistic approach. I obtained various grants to upgrade the Structural and Concrete Laboratory in order to significantly improve student learning experience and also to facilitate fourth year students to produce quality research works.

I continuously endeavour to improve and update my teaching through my participation in professional development workshops/seminars and through self-reflection and evaluation of student and peer feedback. This inquisitive and reflective practice has helped me to craft and enhance skills to become an effective communicator and teacher. My sustained effort in providing high quality education has been evidenced by my consistently outstanding Student Feedback for Teaching and Subject (SFT/SFS) scores in all of the subjects I teach. Formal and informal peer reviews and commendations from the Head of Discipline and the Head of School also attest my dedication and my continuous contribution to support student learning.

### CRITERION 1: APPROACHES TO THE SUPPORT OF LEARNING AND TEACHING THAT INFLUENCE, MOTIVATE AND INSPIRE STUDENTS TO LEARN

My pedagogy consists of two key features: a contextual and a multisensory teaching and learning approach. Research has proven that contextual teaching and learning approach is very effective in engineering education as students can directly relate their learning with the problems they will face in their professional careers (Felder et al., 2000). Before I introduce any new concept to students, I always relate the topic to everyday problems they are familiar with. I believe that tying real-world examples to a concept helps students to understand its relevance and inspires them to learn. For example, I am a volunteer at ReefHQ Aquarium in Townsville and during the process of my volunteer training I learnt that the construction of concrete aquarium tanks in ReefHQ used an innovative technique of injecting liquid nitrogen into the concrete mixing trucks to reduce the temperature of concrete mix and avoid cracking. I used this information and showed actual construction pictures of the ReefHQ tanks when teaching hot-weather concreting in CS3001. The students not only understood the issues related to hot-weather concreting and different preventive measures, but they could also establish its relevance with something they are familiar with. Using this kind of contextual teaching, I am able to achieve better student comprehension and long-term retention of information. The outstanding student feedback scores for my subjects are a testimony of high level of interest and motivation that I can generate in my teaching:

*The teaching staff worked hard to make this subject interesting: 4.8 rating out of 5 (SFS CS3001, 2009)*

*The teaching staff motivated me to do my best work: 4.6 rating out of 5 (SFS CS3001, 2009)*

The design subjects (CS2003 and CS3001) require a high level of comprehension of complicated design standards, and these technical subjects are often thought of as dry and monotonous. My approach to sustain students' interest in these technically challenging subjects is to use visual illustrations and demonstrations wherever possible. Current research in cognitive science have established that visual teaching approaches are important for exploiting students' visual senses to enhance learning and engage their interest (McGrath and Brown, 2005). Following this multisensory teaching and

learning approach, I strategically use pictures, videos, animations and props to explain the underlying concepts. This has helped students to foster deep understanding. SFT remarks like *"Great use of slides to develop background understanding of the codes"* (SFT CS2003, 2010); and *"Rabin made what could have been a dry boring subject interesting"* (SFT CS3001, 2009) are examples of students' endorsement of my teaching methods. Multimedia videos and visual illustrations are interspersed throughout my course materials. For example, when I introduce sustainability in concrete engineering in CS3001, I show a YouTube video about the collapse of civilisation in Easter Island due to unsustainable development practices. This short video was very effective in making students clearly understand the importance of sustainable development. A course opinion survey conducted after this class showed that 96.1% of the class agreed that I clearly explained why sustainability is important in concrete engineering. In another instance, when I was explaining to the class about different kinds of loads that act on structures, I showed an iconic video of the collapse of Tacoma Narrows Bridge in the United States due to wind loading. After watching the video, students instantly appreciated the importance of loads in structural design. Through this multisensory and generationally appropriate approach, I have been able to maintain a very high level of student motivation and engagement in my subjects. This has been clearly evidenced in my peer and student feedback as well:

*"Dr Tuladhar's ability to influence and motivate students is outstanding"* (Peer review by Dr. Madoc Sheehan, 2010)

*"The lecturer's enthusiasm, knowledge and teaching style encouraged students to engage with the subject"* (SFS CS3001, 2009)

*"This lecturer made a genuine effort to interest us in the subject matter. He was always cheerful and enthusiastic"* (SFT CS3001, 2009)

*"He is enthusiastic and makes me want to learn"* (SFT CS3001, 2010)

*"His interest in helping students to understand the course material and in motivating students is outstanding"* (SFT CS3001, 2010)

*"Rabin, you are very enthusiastic about the subjects you teach. I enjoy transport class"* (SFT CS3004, 2010)

*"You make concrete very enjoyable to learn"* (SFT CS3001, 2009)

I always endeavour to create an active learning environment in class to facilitate students to develop critical thinking and problem-solving skills. In the tutorial sessions of the design courses, I formulate sets of original and realistic problems which challenge and engage students. I first outline strategy to solve these problems and then encourage students to discuss among themselves and ask volunteers to come to the blackboard to solve parts of the problem. Students enjoyed this participatory approach as demonstrated by these remarks: *"He encourages participation by asking at random students to contribute on the board"* (SFT CS2003, 2010) and *"Very helpful teacher that involves students well both in class and in tutorials"* (SFT CS2003, 2010). I also periodically review the course content after completion of each section using short oral quizzes to foster an enjoyable learning environment. For example in CS3001, I divided the class into two groups and conducted an oral quiz with the winning group getting a box of chocolates. Even though these informal quizzes do not carry weighting in their final scores, students have shown great interest in them as these informal activities help them to review and reflect on the subject matter.

The motivation that I generate in students through my teaching is also evidenced by my ability to attract some of the brightest students for the final year thesis projects, one of whom was nominated for highly selective CN Barton award. The CN Barton award seminar evening is an important event organized by School of Engineering and Physical Sciences where top four engineering thesis students present their research.

## **CRITERION 2: DEVELOPMENT OF CURRICULA, RESOURCES AND SERVICES THAT REFLECT A COMMAND OF THE FIELD**

Aligned with the JCU's statement of intent to produce graduates with knowledge in sustainable development, I have proactively refreshed the curriculum of CS3001 to embed sustainable development concepts. I had in-depth discussions with sustainability experts from JCU and University of Technology Sydney to develop course materials and resources to revamp the curriculum. This has helped me to effectively introduce sustainability in CS3001 aligned with graduate attributes in sustainable development: knowledge of sustainable development, understanding of sustainable practices and their applications in concrete engineering. To assess the student perception of these changes, I conducted a course opinion survey: 92.1% of students agreed that it is relevant to introduce sustainability in CS3001 and 84.6% students agreed that their understanding of sustainability remarkably improved after attending the course. In his peer review for CS3001, Dr Madoc Sheehan, senior lecturer from School of Engineering and Physical Sciences (2007 recipient of an ALTC citation), commented that *"Rabin's contribution has been instrumental in the development of sustainability as an*

*essential component in civil engineering education*". I have been requested to develop and map the learning pathway for introducing sustainable graduate attributes across the entire civil engineering program.

Design subjects like CS2003 and CS3001 lack sufficient reference books that follow Australian design specifications. This motivated me to develop comprehensive resources for these design subjects and also for CS3004 to facilitate student learning. I use meticulously drawn diagrams, real-world problems and pictures in my lecture notes to induce deep learning and understanding of the subject matter. Students have consistently commented on the high quality of my course materials and the overall structure of the course:

*"I believe that Rabin goes an extra mile when it comes to his lecture notes"*

*"His lecture notes and slides are of great quality, and generate interests in the subject"*

*"Enjoyed your lectures. Thank you for putting so much preparation into your lectures"*

My teaching resources have also been highly commended by my peers including the Head of Discipline. I have been recommended by peers to publish my teaching materials to alleviate the lack of resources in the area. Peer review for my teaching in CS3001 also recognized my effort to develop excellent resources for my teaching: *"Dr Tuladhar's command of his field and the resources he has developed for his students are outstanding"* (Dr Madoc Sheehan).

My work and teaching experiences in some of the leading universities in my field of expertise (University of Canterbury, New Zealand; Saitama University, Japan and Asian Institute of Technology, Thailand) have helped me to bring a wealth of cutting-edge knowledge to the classroom. For example, I lecture on the state-of-the-art developments in bridge design and construction. Student feedback related to this include: *"The teaching was very good, particularly the information provided about developments in concrete that are only just being implemented"* (SFT CS3001, 2009) and *"The subject was interesting and challenging with the information being taught matching the current standards"* (SFT CS3001, 2010).

In addition, I took leadership in applying and obtaining various grants (\$12,000 and \$14,000 from Faculty of Science and Engineering) to upgrade experimental facilities in the Structural and Concrete Laboratories which has helped undergraduate students to carry out experiments more efficiently and safely. The facilities are utilised to scaffold learning experiences. There has been a remarkable improvement in student experience in concrete/structural practical classes after upgrading the laboratories. It also has helped final year honours students to produce quality research.

Before the upgrade of the laboratory: *"Practicals were dodgy sometimes" and "Practical were tedious and quite inaccurate with the outdated equipment provided"* (SFS CS3001, 2009)

After the upgrade of the laboratory: *"Practicals were relevant and educational" and "Well constructed practicals and tutorials that reinforced understanding of materials covered in lectures"* (SFT CS3001, 2010)

I integrate my research strengths and industry links into my subject content and have developed a strong link between research and curriculum. I regularly invite professionals from local industries to deliver special lectures to impart valuable practical perspective to students. In addition, I facilitate students to conduct industry-funded research thesis projects. Expertise of industrial personnel that I can bring into my research and teaching has been very valuable for thesis students as well: *"Involvement of industry has helped me to perceive how this research is functional in the real world, something that is often hard to grasp in the university"* (Simon Nash, thesis student 2010).

Furthermore, I use critical self-reflection through formal and informal peer and student feedbacks to evaluate students' response to my teaching and adapt strategic methods to meet students learning needs. Careful evaluation of SFT/SFS for CS3001 in 2009 indicated that there is a room for improvement in experimental facilities in the Structural and Concrete Laboratories. This was the impetus behind my effort to upgrade the laboratories through the Faculty funding. There was a remarkable improvement in student learning experiences after upgrading the laboratories. Further example include SFS comment in 2009: *"The field trip could be improved by going to an actual construction site"*. Acting on this valid suggestion, in 2010 I took students to the real construction site at Douglas Arterial Duplication Project which was very informative for students. Furthermore, I continuously strive to improve and update myself through my sustained participation in Teaching Learning and Development workshops and other professional development activities which are instrumental in enhancing my communication and teaching skills.

#### **RECOGNITION OF MY CONTRIBUTION TO ENHANCE STUDENT ENGAGEMENT AND LEARNING EXPERIENCE:**

For all the subjects I teach, I formulate clear instructional objectives to keep the students informed about the key skills they need to master in the course. The well structured layout of my course content is also a reason behind high level of student interest in my subjects which is manifested by the following SFS results:

*The staff made it clear right from the start what they expected from the students: 4.6/5 (CS3001)*

*The assessment requirement and criteria were clearly specified: 4.5/5 (CS3001)*

My continuous endeavour in catering for an active student-centred learning environment through various effective teaching and learning practices has inspired students to learn and has encouraged them to perform at their best: *"Rabin's determination for his student's to perform at their best is ever present, and his assistance has been second to none" (Simon Nash, thesis student 2010)*. My teaching is rated as "outstanding" by my peers including the Head of Discipline and the Head of School. The Head of School encouraged me to apply for the Citation and mentioned *"I (and several others in the School and Faculty) am aware of your outstanding performance in teaching. You must be congratulated on these achievements" (Unsolicited email, HOS 2010)*.

My SFS/SFT scores have been consistently very high in all the subjects I have taught and are well above the average score for the school and the university. Some of the widely used comments in my students' survey are:

*"Rabin has been one of the most effective lecturers I have experienced at JCU"*

*"He is by far the best lecturer"*

*"Without a doubt you would have to be one of the best lecturers in Engineering, if not the best"*

*"CS2003 is one of the best subjects and learning experience I have had at JCU to date. Thank you for your commitment and learning experiences"*

The average SFS score for CS3001 in 2009 was 4.5 out of 5 and the response was 4.8 out of 5 for the questions: *"The teaching and learning experiences for this subject were well organized"* and *"Overall, I am satisfied with the quality of this subject"*. SFT survey results for my subjects demonstrate my sustained contribution in maintaining a high quality teaching and learning environment. My self-reflective practice has contributed to consistent improvement of my performance which is evident in the SFT survey Table below.

SFT Results out of 5	CS2003		CS3001		CS3004
Questions/year	2009	2010	2009	2010	2010
1. The teacher is well organized	4.5	4.9	4.4	4.9	4.6
2. This teacher communicates clearly	4.1	4.8	4.1	4.9	4.5
5. This teacher appears knowledgeable in the subject area	4.8	4.9	4.5	4.9	4.5
7. This teacher makes the subject interesting	4.1	4.6	4.3	4.7	4.2
8. This teacher involves students	3.9	4.5	4.3	4.5	4.1
10. This teacher makes a good use of available information technology	4.41	4.5	4.5	4.7	4.6
<b>Total average SFT for the subject</b>	<b>4.1</b>	<b>4.7</b>	<b>4.3</b>	<b>4.8</b>	<b>4.4</b>

Scale: 1=completely unacceptable, 2 = not really acceptable, 3 = acceptable, 4 = more than acceptable, 5 = outstanding

My leadership in my professional field is demonstrated by my active involvement in establishing the Concrete Institute of Australia North Queensland (CIANQ) committee in Townsville, which is the first regional committee of Concrete Institute of Australia (CIA). I am currently serving as the General Secretary for CIANQ. Through CIANQ, I organized a one day seminar on "Concrete in the Tropics" in April 22, 2010 in Townsville in partnership with Engineers Australia and JCU. This seminar was first-of-its-kind in Townsville and was attended by more than 90 local engineers, concrete professionals and students. Participants comments like: *"The seminar was very interesting and useful"* and *"Fantastic to see this sort of event in Townsville"* shows the appreciation from the wider community. Enthusiastic participation of undergraduate students (15) in this seminar demonstrates my ability to inspire students to a life-long learning process. This seminar also gave an excellent networking platform for undergraduate and post-graduate students.

In conclusion, my contribution to student learning has received praise from peers and students and it is well demonstrated by my sustained high scores in student feedback surveys. I have proactively developed and refreshed course materials and resources for my subjects to meet the desired graduate attributes. I continuously seek to improve myself through peer and student feedback and professional development activities. Moreover, I have demonstrated leadership through various professional activities which has directly benefited my teaching as well.

## REFERENCES:

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