For Technology Enhanced Cognitive Scaffolding: An innovative method for effective teaching of Pathology in a rural medical school

BACKGROUND AND OVERVIEW:

Being a sole academic pathologist in a rural medical school creates both challenges and opportunities for the development of innovative, technological approaches to learning and teaching. I came to Australia in 2005, as the only full time Pathologist in the James Cook University School of Medicine and Dentistry (SMD). On my first day in class, I had the sudden awareness of challenges ahead, when I saw over 90 enthusiastic students sitting eagerly to learn Pathology, How am I going to teach them individually pathology knowledge, practical skills, specimens, microscopy, assessment, and support them, alone….?

Pathology is an essential pre-clinical foundation of medicine and prepares students for clinical practice. This complex subject requires extensive theoretical knowledge, laboratory and microscopy skills and is traditionally delivered by a team of pathologists, technical and support staff. Before my arrival in SMD, pathology was taught in block mode during weekends by a visiting pathologist an evidence of severity of situation in pathology. As a result, students received only limited pathology teaching. Also this problem is recently compounded by increasing student numbers. Taking our own example, At JCU-SMD the annual intake has doubled over the previous 5 years. All of which led to significant problems with the delivery of the Pathology curriculum. Interestingly this is not just a local problem, but universal in medical schools nationally and internationally. Most medical schools have reduced basic science teaching.

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

Since 2005, I have been stimulated to develop and implement innovative techniques to improve teaching. This work is summarised in five innovative approaches to the support of learning and teaching that influence, motivate and inspire students to effectively learn Pathology.

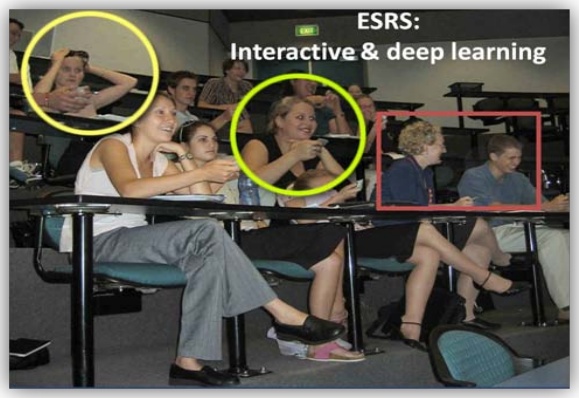
Innovation 1: A New Integrated Curriculum: Change from a traditional curriculum to the new "Integrated Clinical Pathology Curriculum" based on the principles of "Work Integrated Learning (WIL)" using "Clinical-Pathology-Case studies" (CPC). These transform Pathology from a book-based, complex and dry subject into clinically-relevant learning. These case studies assist students to understand and apply pathology knowledge to the clinical reasoning required for the patient cases. I delivered all the CPC materials, lectures, podcasts and other study aids online to allow flexible access across multiple sites.
Having contemporised the pathology curriculum, I began thinking of improving other areas; especially practical skills teaching and methods to assess and support students, drawing on my MBA studies in educational leadership.

Innovation 2: – Video Broadcasting: Large student numbers precluded teaching practical skills with pathology specimens in small groups, so I replaced this traditional approach with video broadcasting. In partnership with the IT department, a modern pathology teaching laboratory was designed with video broadcasting and a relay system that projected my explanation of the specimens to multiple screens and recorded video webcasts for off campus students.

Innovation 3: Digital Microscopy: Microscopy is the most resource intensive and complex teaching in pathology, compounded by the large student cohort. First I took the idea of digital slides used in Pathology conference seminars and combined them with a computer teaching tool used in Lan-Schools which broadcasts a teacher's computer screen to all student computers. Then I prepared a complete set of teaching pathology slides with annotations and instructions built inside the digital slides. Then I designed the digital microscopy laboratory in consultations with computer engineers. A peer-reviewed, evaluation of our approach has been published (Sivamalai.S 2011).With this tool, students get a full experience of traditional microscopy on their computer screen with clear images, full control and zooming, just like with a microscope. In addition they get built in explanations and annotations. These digital webslides can be accessed any time through the internet.

Innovation 4: Electronic Student Response System (ESRS):

The next challenge was to know if students are learning effectively. Assessing pathology knowledge and practical skills requires an extensive laboratory setup with one-to-one testing. For this, I introduced an ESRS similar to the system used in television programs for audience voting. I created pathology case scenarios with clinical information and pathology images of specimens, microscopy and relevant clinical data. Students answer by clicking on their remote controls. The software displays results immediately on the screen, giving instant feedback and also stores the student responses. With this system, I can get complete data on students understanding. of theory, practical skills and their clinical application. Use of ESRS has resulted in significantly improved student participation, motivation and learning.



Innovation 5: Winners Club: By using the ESRS system, I realised I could now identify early in the year, the students who performed poorly, and thus at high risk of failure at the end of year. I had an opportunity to help them in time. With this idea, I initiated the "Winners Club"; based on two theories "Collaborative Learning" and "Cognitive Scaffolding" that I learnt in my MBA in Educational Leadership" course. Cognitive Scaffolding is *what a teacher does when working with a student to solve a problem, carry out a task, or achieve a goal which would be beyond his unassisted efforts.(Wood D 1976).* Romberg and Carpenter (Rhomberg TA, 1986) further developed the theory that cognitive scaffolding should involve inquiry as a matter of steps or phases

conducted in succession or in cycles, expressed in terms of expected student cognition. Collaborative learning is known to be a powerful tool for gaining both understanding and deeper knowledge levels.

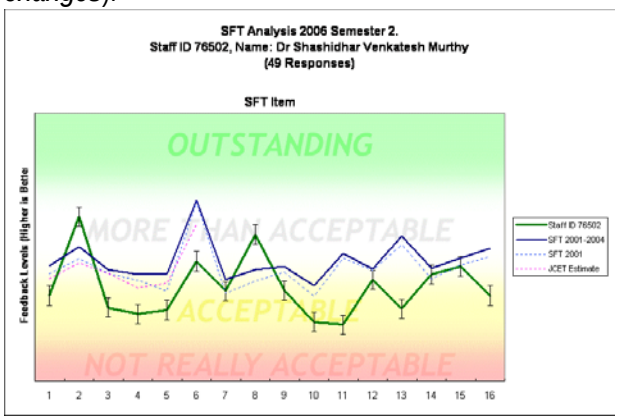
The Digital Microscopy Teaching Laboratory, Winners Club & Electronic Student Response System in Teaching Pathology are effective innovations I have introduced to JCU.

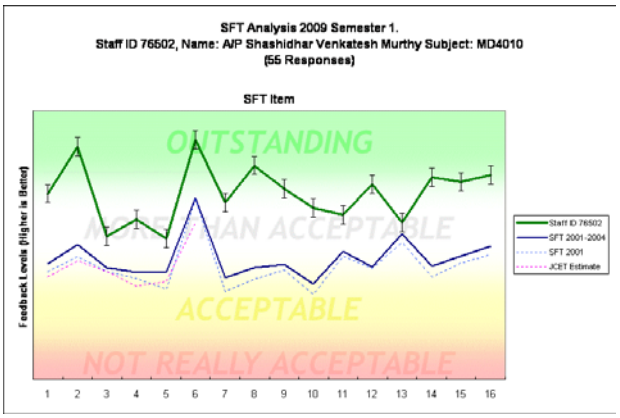
EVIDENCE OF SUSTAINED IMPACT ON STUDENT MOTIVATION AND LEARNING

Together, these integrated approaches in the Year 4 pathology course have resulted in significant improvements in student motivation, performance and satisfaction. In 2006, before I implemented these innovations, average class performance as measured by final exam results was 68%. Peformance has steadily improved every year and last year the class average was *74%*, the highest in the school's history.

These improvements in final results which show overall better performance, support the view that Pathology learning significantly improves overall clinical performance.

The 2006 SFT chart (before implementation of changes) compared with 2009 chart (after implementation of changes):





The questions comprehensively cover academic feedback about teaching. Student response ranges from not acceptable at the bottom to outstanding at the top. The University average (Blue solid line) compared with my feedback (Green solid line) clearly shows significant improvement from below the University average to outstanding feedback in the course of the development I have initiated.

SELECTED COMMENTS FROM STUDENT FEEDBACK ON TEACHING (SFT):

- *"Best lecturer ever" always concerned about improving our learning.*
- *The keepad quizzes (ESRS) at the end of the lecture are a fantastic way to reinforce the content we just learnt. Thank you.*
- *Shashi is very enthusiastic about his teaching…., Everything you have done for us is great… Motivation to teach was great….., Excellent lecturer, great enthusiasm……., very motivated to be a mentor, active in encouraging students to improve….,*
- Winner's Club students: *Shashi teaches you how to retain knowledge in a meaningful way*
- *I don't think it is possible for me to get a HD, but he [Shashi] makes it OK. He wants us to be confident and competent- that I know the main reasons for an M-valve,*
- *His enthusiasm in ensuring all students achieve top marks is fantastic.*

PEER RECOGNITION OF MY CONTRIBUTION TO TEACHING AND LEARNING:

Dr. Peta-Ann Teague: Clinical Year 4 coordinator: *it's great to come across a teacher who is so enthusiastic and interested in getting student feedback. Every 4th year student I come across at the moment is pleased with the quality of teaching they are getting. His enthusiasm for his subject, the high quality of his teaching material and the clarity of his lectures have made him a popular and well regarded lecturer amongst both staff and students alike* (2009)

Louis Peachey, Clinician and Student supervisor, Mount Isa, Rural Health Centre: (Email to Year coordinator) "*So far the feedback from the medical staff has been excellent. There have been a number of preceptors who have noted the substantial difference between this years 4th yrs and last years 4th yrs. A number of their preceptors in the hospital, who are not easily impressed, have gone out of their way to tell me how impressed they have been with this group. Also for the record, I am looking forward to Shashi's visit as a source of my own learning*" (2006)

Tarun Sen Gupta A/Prof. Head, General Practice & Rural Medicine & Director of Medical Education: *Shashidhar has been at the forefront of educational innovation, and has generously shared his expertise in this area with colleagues at schools professional development sessions. He has also taken his expertise and school name to national and international conferences.* (2009)

Richard Murray, Dean JCU SOMD: "*Under Shashi's leadership, the development of the MBBS year 4 pathology curriculum with its focus on case and problem-oriented learning has been a great success*. (2010)

AMC Accreditation Team (2010): While in a meeting with staff, the accreditation team member (Prof. J Nicky Hudson, University of Wollongong) said "I have heard a lot about innovations in pathology teaching here..!"

Following my presentations at national and international conferences, I have responded to several requests for establishing similar teaching tools in other medical schools. Below are two recent parternships I am working with:

1. Flinders University School of Medicine, Adelaide which is establishing the Northern Territory Medical Program(NTMP) a new rural medical school based in Alice Springs NT, sent their pathologist in 2010, following consultations with me, to visit our teaching facility to implement the same in Alice Springs.
2. The Vice Chancellor of Manipal University, India, came to Townsville in 2010, and has appointed me as adjunct Professor of Pathology to facilitate establishment of our pathology teaching innovations and the sharing of my teaching experience with their staff. I am planning to visit Manipal to establish a pathology teaching facility there.

CONFERENCE PRESENTATIONS WHERE THESE INNOVATIONS WERE PRESENTED:

- Shashidhar Venkatesh (2008) "Interactive pathology teaching using electronic student response system (ESRS) to 4th year medical students at James cook university school of Medicine. Papers from Pathology Update 2008, 14 March 2008, Sydney, NSW.
- Shashidhar Venkatesh (2007) "In-class assessment using student response system" Second International Clinical Skills Conference, Prato Monash Centre, Tuscany 1-4 July 2007.
- Interactive Pathology teaching using electronic student response system (ESRS) to 4th Year MBBS Students in James Cook University. Presented at Annual Pathology Conference (Pathology Update), Sydney AUSTRALIA. March 2009.
- Conducted Workshop on Pedagogy for Postgraduate students of VS Dental College & Hospital, Bangalore India. Feb 2010.
- Presented Workshop on Medical Education & talk on "Pathology Teaching using technology enhanced cognitive scaffolding (TECS)" at Melaka Manipal Medical College, Manipal India Feb 2010.

Following my presentations at conferences, I have been assisting other medical schools both national and international to implement these tools.

Publication: Sundram Sivamalai, Shashidhar Venkatesh Murthy, Tarun Sen Gupta and Torres Woolley, "Teaching pathology via online digital microscopy: Positive learning outcomes for rurally based medical students". *Aust. J. Rural Health* (2011) 19, 45–51.