Teaching Portfolio

Craig W. Clarkson, PhD

Professor of Pharmacology

Section 1: Biography

Dr. Clarkson was born in Waupaca, a small town in central Wisconsin. Being the son of an army dentist, he ended up living in several states during his formative years (Alaska, Texas, Michigan & Washington) as well as in two locations in Germany (Pirmasens & Munich). Dr. Clarkson obtained his undergraduate training at the University of Puget Sound in Tacoma WA where he graduated with a BS in Biology & Chemistry in 1977. One of the elective courses Dr. Clarkson took during his 2nd year in college was a one month course on marine biology in Hawaii where he worked with a team to refine HPLC techniques to purify a marine toxin (Ciguatera) responsible for causing major health problems in the South Pacific & Carribean. This project sparked an interest in pharmacology, and was the catalyst for causing him to enter graduate school in pharmacology at Northwestern University under the mentorship of Robert E TenEick, PhD. After receiving his PhD in 1982 he completed 3 years of postdoctoral training under Luc Hondeghem, MD, PhD at the University of California, San Francisco.

In 1985, Dr. Clarkson joined the faculty at Tulane as an assistant professor in pharmacology. Over the years he took on an increased responsibility for teaching including the role of course director for Medical Pharmacology in 1997. Following hurricane Katrina, he also took over the responsibility of director of graduate studies for the pharmacology department's doctoral and masters programs.

Dr. Clarkson believes that adults learn most effectively when they are actively engaged in their own learning. As a result, he has helped to implement several interactive, learner-centered approaches into the medical curriculum including problem based learning, team based learning, just-in-time-teaching and peer instruction. He is the recipient of 11 teaching awards from the medical student's honor society (Owl Club), as well as the Sr Vice President's Teaching Scholar award, the Tulane President's Award for Excellence in Teaching & the Alpha Omega Alpha Robert Glaser Teaching Award. At Tulane, he serves as the Chair of the Educational Technology Committee & the Student Affairs Committee. He is also a member of the Curriculum Committee, T2 Curriculum Subcommittee, Evaluation & Assessment Committee, and the Biomedical Sciences Steering Committee. On a national level, Dr. Clarkson is a member of the American Society for Pharmacology & Experimental Therapeutics (ASPET), the National Directors of Graduate Studies in Pharmacology & the International Association of Medical School Educators (IAMSE). He has also served as the Medical Schools Representative to the United States Pharmacopeial Convention (2005-2010).

Section 2: Teaching Vitae

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URL: http://tulane.edu/som/departments/pharmacology/clarkson.cfm

Personal Background:

- Born on September 22, 1955, Waupaca Wisconsin.

Professional and Academic History:

- B.S. in Biology and Chemistry 1977
  Univ. of Puget Sound, Tacoma WA
- Ph.D. in Pharmacology 1982
  Northwestern Univ., Chicago, IL
- Postdoctoral Research Pharmacologist 1982-1985
  Dept. of Pharmacology, Univ Calif San Francisco
- Assistant Professor 1985-1990
  Dept. of Pharmacology, Tulane Univ.,
  School of Medicine, New Orleans LA
- Associate Professor 1990-1995
  Dept. of Pharmacology, Tulane Univ.,
  School of Medicine, New Orleans LA
- Professor 1995-present
  Dept. of Pharmacology Tulane Univ.,
  School of Medicine, New Orleans LA
- Director of Graduate Studies in Pharmacology 2005-present
  Dept. of Pharmacology, MS & PhD programs
  Tulane Univ., School of Medicine, New Orleans LA

Education-Related Honors & Awards:

- Owl Club Teaching Honor Roll* 1997
- Owl Club Teaching Award - Outstanding 2nd Year Teaching Award 1998
- Owl Club Second Year – Outstanding Professor, 2nd Semester 2001
- Owl Club Second Year – Student Advocate 2002
- Owl Club Second Year – Professor of the Year, Honorable Mention 2004
- Owl Club Second Year – Professor of the Year Teaching Award 2006
- Owl Club Second Year – Category 5 Teaching Award** 2006

- Owl Club Second Year – Professor of the Year Teaching Award 2007
- Owl Club Second Year – Professor of the Year Teaching Award 2008
- Senior Vice President's Teaching Scholar Award (Tulane SOM) 2008
- President's Award for Excellence in Teaching (Tulane Univ) 2008
- Owl Club Second Year – Professor of the Year, Honorable Mention 2009
- Owl Club Second Year – Clifford Newman Student Advocacy Award
  (for Members of the TmedWeb Team). 2009
- Alpha Omega Alpha Medical Honor Society Teaching Award
  Tulane University School of Medicine 2009
- Owl Club Second Year – Professor of the Year Teaching Award 2011
- Gloria P Walsh Award for Teaching Excellence (Owl Club) 2011
- Owl Club Second Year - Honorable Mention Best T2 Professor 2012
  I'm not sure, but I think this is like coming in 5th place in the Olympics
- Owl Club T2 "Humerus" Award 2013
- Owl Club T2 "Humerus" Award 2014
- Owl Club T2 Best PBL or TBL Facilitator Teaching award 2015
- Owl Club T2 Professor of the year Teaching award 2016
- Fellow of the Academy of Pharmacology Educators (ASPET) 2017
- Owl Club Leon A Weisberg Excellence in Clinical Teaching Award 2017
- Owl Club T2 Teaching Excellence Award 2017
- Owl Club T1 Module of the Year (Cardiovascular) Award 2017
- Owl Club T2 Best PBL or TBL Facilitator Award 2017

* Tulane Univ School of Medicine (Student Honor Society)

** "For the five exceptional individuals keeping medical education afloat come hell and high water." Awarded the year after Hurricane Katrina.

Educational Grant Funding:

- Tulane Office of Educational Research & Services. Teaching & Learning Innovations in Medical Education Incentive Mini-Grant (TIME).
  Craig W. Clarkson, P.I. "Digital Video Recording of Cardiovascular Drug Responses For Replacement of Live Animal Labs" 1999-2000. $3,000.

Educational Professional Memberships:

- International Association of Medical Science Educators (IAMSE) 2003-present
- Tulane University Society of Teaching Scholars, School of Medicine 2008-present
- Academy of Pharmacology Educators (ASPET) 2017-present

Visiting Professorships / External Department Reviews:

- American University of Antigua College of Medicine, Dept. of Pharmacology, Antigua, Caribbean. April 2005 & February 2006. Nine hours of lectures to medical students.
- St. George's University, School of Medicine. External Review/Site Visit of the Dept. of Pharmacology & Medical Pharmacology course, St. George's, Grenada, April 5-8, 2009

Course Director Positions:

▪ Medical Pharmacology (2nd year medical course)	1997-present
▪ Advanced Topics in Cardiovascular Pharmacology (Graduate)	2000-2013
▪ Systems Biology (BMS Doctoral Program)	2007-2012
▪ Concepts in Pharmacology (Masters program) (1 yr pilot project involving active learning in grad education)	2008
▪ Principles of Pharmacology (Graduate)	2010-present
▪ Mol & Cell Pharm (formerly Pharm Research)(Graduate)	2010-present
▪ Pharmacology ePortfolio (Graduate)	2011-present
▪ HEAL-X Cardiovascular block Co-director (w/ Dr. Elma LeDoux)	2013 & 2014

Graduate Teaching:

- Cardiac Physiology
- Whole Animal Electrocardiography
- Cardiac Arrhythmias
- Membrane transporters & mitochondrial function
- Drug Receptor Theory / Basic Principles of Pharmacology

Medical Teaching:

Medical Physiology (1st year) - Lectures

- Principles of Cardiac Excitation & Contraction (2hrs)
- Introduction to the electrocardiogram (1 hr)

Medical Physiology (1st year) - JiTT Sessions

- Cardiac Arrhythmias, Cellular Basis & ECG Interpretation (2 hrs)

Medical Pharmacology (2nd year) – Lectures

- Pharmacokinetics
- Hepatic Drug Clearance
- Antianginal Drugs

- Drugs used in Rx of Asthma
- General & Local Anesthetics
- Sedative / Hypnotic / Anxiolytics
- Antipsychotics
- Psychostimulants, Drugs of Abuse
- Drug Responses in Children, Women & the Elderly
- Herbal Drugs

Medical Pharmacology (2nd year) – JiTT Sessions

- Basic Principles of Medical Pharmacology JiTT
- Cholinergic Pharmacology JiTT
- Antiarrhythmic Drugs JiTT
- Treatment of Heart Failure & Digoxin Pharm JiTT
- Antidepressants, MAO inhibitors & Li JiTT

Medical Pharmacology (2nd year) – Block Reviews

- Basic Principles & Rx of Inflammation
- ANS & CV Pharmacology
- Renal Block
- CNS Drugs / Neurology Block
- Psychiatry block
- Endocrine & Reproductive Block

Medical Pharmacology (2nd year) - Team Based Learning

- Autonomic Unknowns
- Rx of Diabetes
- Rx of Heart Failure (a collaboration with Dr. Elma LeDoux)
- Coagulation Disorders (a collaboration with Dr. Marc Kahn)

Medical Pharmacology (2nd year) - Problem Based Teaching

- Drug Metabolism & Drug Interactions
- Chemical Warfare in Iraq
- Hypertension
- Antiarrhythmic Drugs & Rx of acute MI - Clinical Problem Solving
- Oral Contraceptives – Clinical Problem Solving
- Treatment of Depression – Clinical Problem Solving

Human Patient Simulation (2nd year) - METIman (Adult & Pediatric)

- Diagnosis & Treatment of Unstable Angina & Cardiac Arrhythmias
  (a collaborative project with Dr. Elma LeDoux MD)

- Diagnosis & Treatment of Acute Bronchoconstriction (pediatric) - currently not being used
  (a collaborative project with Dr. Scott Davis, MD)
- Diagnosis & Treatment of Severe Pain - gunshot wound
  (a collaborative project with Dr. Elma LeDoux MD)

Case-based Learning Modules with Self Assessment (2nd year) - Pharmwiki

(include: clinical case, pathophysiology, clinical diagnosis, treatment, interactive quizzes)

- Antimalarials
- Rx of Hypertension
- Rx of BPH
- Rx of Asthma
- Rx of Angina
- Rx of IBS & IBD
- Introduction to CNS neurotransmitters & Rx of Alzheimers
- Rx of Migraine
- Alcoholism
- Contraceptives
- Rx of Diabetes (insulins, oral & parenteral hypoglycemics)
- Rx of Depression
- Rx of Schizophrenia

Education Related Committees:

University or Medical Center

Academic Computing	1988-1993
Surgery Required Clerkship Review Committee	1991-1993
Admissions Committee	1994-1999, 2005-present
Senate Committee on Honors	1997-1999
Graduate Council	1997-2000
University Senate Committee on Computing	1998-2001
Curriculum Committee	1999-present
2nd Year Clinical Curriculum Advisory Committee	1997-present
Student Affairs Committee (**chair** since 2009)	2004-present
Educational Technology Committee (**chair**)	2007- present
Evaluation & Assessment Committee – SOM	2008-present
Simulation Center Research Committee	2010-present (inactive)

MEDICAL EDUCATION:

Course Director for Medical Pharmacology (1997 to present)

For the past ~ 20 years I have been the course director for this team-taught course that currently consists of 54 hours of lectures (many with clicker questions), 7 hours of small group cased-based Problem-Based-Learning (PBL) sessions, 8 hours of Team-Based-Learning sessions (4 TBLs), 10 cased-based online learning wiki modules with interactive self assessment exercises, 9 Just-in-Time-Teaching (JiTT) sessions, 2 Simulation sessions, 10 hrs of block review sessions & 11 hours of exams (111 hours total). I am personally responsible for teaching 20 hrs (~25%) of lectures & JiTT sessions, 2 of the 4 TBLs, 2 HPS Simulation exercises (12 sessions each) & participate in all PBL exercises. In addition, I am responsible for scheduling, curricular development, continuing development of our wiki website (Pharmwiki), exam development, exam grading & evaluation, and working with other course directors involved in our 2nd year medical curriculum who have courses that "dove-tail" with our content in our integrated medical curriculum. Teaching this course involves a total of over a dozen different faculty from pharmacology, psychiatry & medicine.

Med Pharm was awarded the Owl Club "Course of the Year" Award in April/May 1998, 2000, 2008 & 2009, 2011 & 2016.

The Katrina Experiment in Medical Education

In the Fall of 2005, following hurricane Katrina, most of the New Orleans area was under several feet of water for several weeks. At this time, the senior leadership in the School of Medicine (Drs. Kahn, Krane & Dean Taylor) developed a partnership with Dr. DeBakey & the Baylor College of Medicine, who offered the use of their medical campus to allow us to "restart" our school of medicine for the next 9 months in Houston. A handful of close colleagues from different departments (Drs. Beckman, Crawford, Daroca, Johnson, Kahn, Krane, Markert, Smith & Rajan) and myself relocated to Houston in mid September to put together a 2nd year medical curriculum utilizing a mixture of faculty from Baylor, MD Anderson & Tulane. We identified and contacted available teaching faculty, developed lecture handouts, and organized the 2nd year curriculum in 2-3 week blocks, working on the next block while the current block was being delivered. BCM faculty & students utilized their classrooms for lectures & small group sessions in the morning, and we utilized them in the afternoon. We all learned to give lectures on topics outside of our normal comfort zone, but we nevertheless managed to provide "almost" the same quality of curriculum (based upon performance on both internal & standardized NBME shelf exams) that we provided for our students in New Orleans. It was an interesting educational experiment, but not one that any of us would care to repeat anytime soon.

Facilitating Student Learning Thru Lecture Recording

The average student can only transcribe 10% of the words spoken during a typical lecture. It is widely believed that having a resource for reviewing lecture content "after the fact" can aid student learning. During the summer of 2006, after returning from Houston, I worked with Niels Olson (a Naval engineer, and previous 4th year medical student) to develop a system for recording lectures to be given during the upcoming 2nd year medical curriculum. We settled upon using an Olympus digital audio recorder connected to an audio feed from the podium. Niels did the lion's share of recording, and I created & managed a website for uploading & storing the recordings. By the end of the year this evolved into the development of a "one stop shopping" web site where lecture slides and audio files for all T2 lectures could be easily found & downloaded with little navigation involved. The following year, I began a

collaboration with Bobby Garner-Coffie in the SPH/TM that allowed us to perform a pilot study using the Tegrity Classroom system for lecture capture of Med Pharm lectures. The following 2007-08 year the use of Tegrity was expanded to include recording of all T2 courses, and to a limited extent, for recording 1st year lectures. The use of the system was then expanded further to include the entire 1st & 2nd year medical curriculum, with funding provided by the SOM Deans office. In 2014 a University wide subcommittee was formed to evaluate different recording options, and shortly thereafter we switched to using Mediasite as our classroom recording platform.

Related Educational Presentation & Publication:

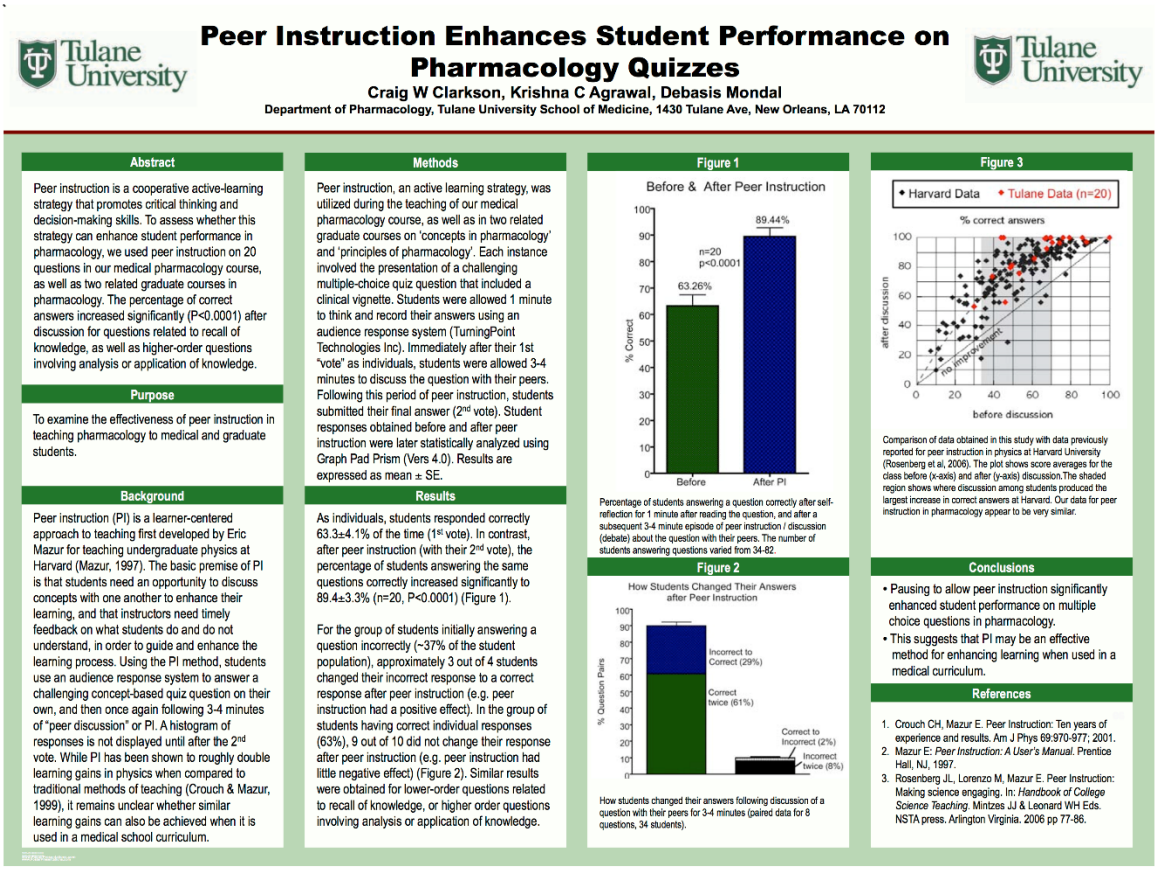
- Franklin DS, Gibson JW, Samuel JC, Teeter WA, Clarkson CW: Use and benefits of lecture recordings in medical education. Southern Group on Educational Affairs. 2009 Annual Meeting, New Orleans, LA. Poster/Abstract #233.
- Franklin DS, Gibson JW, Samuel JC, Teeter WA, Clarkson CW: Use of lecture recordings in medical education. Med Sci Educator 21(1): 21-28, 2011.

Introduction of Active Learning Strategies

Just-in-Time-Teaching (JiTT) & Peer Instruction

Traditional classroom lectures are “teacher-centered” and promote passive learning. There is a growing body of evidence that indicates that active learning strategies can produce superior learning outcomes compared to traditional lectures. As a first step in implementing learner-centered / active learning strategies, in 2008-2009 we converted seven traditional Med Pharm lectures to Just-in-Time-Teaching sessions. JiTT sessions require that students complete a reading assignment & a post-reading (graded) quiz on a LMS (e.g. Blackboard or Canvas) that has a deadline the night before the class session (e.g. the LMS will close access to the quiz at midnight or 3 AM). The quiz typically contains 2 or 3 MCQs, plus a short answer essay question. The essay question asks students to reflect on the assignments learning objectives and to briefly explain “What did you find most difficult or confusing about the reading?” (a method designed to cause metacognition). These essay responses are scanned the morning before class & determine the areas to be focused on during class. Selection of previously created interactive Audience Response System (clicker) questions before class that are related to the identified areas of difficulty transforms a traditional lecture into a class session focused mainly on areas of difficulty (vs. a review of material the class already understands from their reading). Students come to class prepared with a background knowledge of the material.

When clicker questions are utilized to stimulate discussion between students, the student interaction (referred to as "peer instruction") can produce a significant increase in short term understanding (as illustrated in the poster presentation shown below)(or see a larger version).



Peer Instruction Enhances Student Performance on Pharmacology Quizzes

Craig W Clarkson, Krishna C Agrawal, Debasis Mondal

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Abstract

Peer instruction is a cooperative active-learning strategy that promotes critical thinking and decision-making skills. To assess whether this strategy can enhance student performance in pharmacology, we used peer instruction on 20 questions in our medical pharmacology course, as well as two related graduate courses in pharmacology. The percentage of correct answers increased significantly (P<0.0001) after discussion for questions related to recall of knowledge, as well as higher-order questions involving analysis or application of knowledge.

Purpose

To examine the effectiveness of peer instruction in teaching pharmacology to medical and graduate students.

Background

Peer instruction (PI) is a learner-centered approach to teaching first developed by Eric Mazur for teaching undergraduate physics at Harvard (Mazur, 1997). The basic premise of PI is that students need an opportunity to discuss concepts with one another to enhance their learning, and that instructors need timely feedback on what students do and do not understand, in order to guide and enhance the learning process. Using the PI method, students use an audience response system to answer a challenging concept-based quiz question on their own, and then once again following 3-4 minutes of "peer discussion" or PI. A histogram of responses is not displayed until after the 2nd vote. While PI has been shown to roughly double learning gains in physics when compared to traditional methods of teaching (Crouch & Mazur, 1999), it remains unclear whether similar learning gains can also be achieved when it is used in a medical school curriculum.

Methods

Peer instruction, an active learning strategy, was utilized during the teaching of our medical pharmacology course, as well as in two related graduate courses on 'concepts in pharmacology' and 'principles of pharmacology'. Each instance involved the presentation of a challenging multiple-choice quiz question that included a clinical vignette. Students were allowed 1 minute to think and record their answers using an audience response system (TurningPoint Technologies Inc). Immediately after their 1st "vote" as individuals, students were allowed 3-4 minutes to discuss the question with their peers. Following this period of peer instruction, students submitted their final answer (2nd vote). Student responses obtained before and after peer instruction were later statistically analyzed using Graph Pad Prism (Vers 4.0). Results are expressed as mean ± SE.

Results

As individuals, students responded correctly 63.3±4.1% of the time (1st vote). In contrast, after peer instruction (with their 2nd vote), the percentage of students answering the same questions correctly increased significantly to 89.4±3.3% (n=20, P<0.0001) (Figure 1).

For the group of students initially answering a question incorrectly (~37% of the student population), approximately 3 out of 4 students changed their incorrect response to a correct response after peer instruction (e.g. peer instruction had a positive effect). In the group of students having correct individual responses (63%), 9 out of 10 did not change their response after peer instruction (e.g. peer instruction had little negative effect) (Figure 2). Similar results were obtained for lower-order questions related to recall of knowledge, or higher order questions involving analysis or application of knowledge.

Figure 1

Percentage of students answering a question correctly after self-reflection for 1 minute after reading the question, and after a subsequent 3-4 minute episode of peer instruction / discussion (debate) about the question with their peers. The number of students answering questions varied from 34-82.

Figure 2

How students changed their answers following discussion of a question with their peers for 3-4 minutes (paired data for 8 questions, 34 students).

Figure 3

Comparison of data obtained in this study with data previously reported for peer instruction in physics at Harvard University (Rosenberg et al, 2006). The plot shows score averages for the class before (x-axis) and after (y-axis) discussion.The shaded region shows where discussion among students produced the largest increase in correct answers at Harvard. Our data for peer instruction in pharmacology appear to be very similar.

Conclusions

- Pausing to allow peer instruction significantly enhanced student performance on multiple choice questions in pharmacology.
- This suggests that PI may be an effective method for enhancing learning when used in a medical curriculum.

References

1. Crouch CH, Mazur E. Peer Instruction: Ten years of experience and results. Am J Phys 69:970-977; 2001.
2. Mazur E: *Peer Instruction: A User's Manual*. Prentice Hall, NJ, 1997.
3. Rosenberg JL, Lorenzo M, Mazur E. Peer Instruction: Making science engaging. In: *Handbook of College Science Teaching*. Mintzes JJ & Leonard WH Eds. NSTA press. Arlington Virginia. 2006 pp 77-86.

Related Educational Presentations & Workshops:

- *Peer instruction enhances student performance on pharmacology quizzes*. Clarkson CW, Agrawal KC, Mondal D. Southern Group on Educational Affairs. 2009 Annual Meeting, New Orleans, LA. Abstract/Poster #249.
- *Active Learning & Learner-Centered Instruction. Changing the Emphasis from Teaching to Learning.* Meeting of the National Directors of Graduate Studies in Pharmacology (New Orleans, LA, April 23rd, 2009)
- *Small group workshop on Active Learning* - National Directors of Graduate Studies in Pharmacology (New Orleans, LA, April 23rd, 2009)
- *Active Learning* - Robert Glaser Teaching Award (Post-dinner talk). Alpha Omega Alpha Medical Honor Society (New Orleans, LA, April 22nd, 2009)
- *Just-in-Time-Teaching & Classroom Response Systems. Changing the Emphasis from Teaching to Learning.* Annual Meeting of the Group for Research in Pathology Education (GRIPE), Jan 15, 2010. New Orleans, LA.
- *IAMSE Workshop on Just-in-Time-Teaching in Medical Education.*Clarkson CW, Franklin, D International Asson. of Medical School Educators (IAMSE) Meeting, Portland OR, June 25th, 2012.

Team Based Learning (TBL)

The same year that I introduced JiTT into our medical curriculum, I also worked with Drs Kahn, Krane, Crawford and several other faculty to develop and introduce several sessions utilizing the Team Based

Learning method (for further information, see http://www.teambasedlearning.org/). The TBL design has similarities to JiTT, but utilizes class time primarily for assessment and group exercises. During the first semester that we initiated TBL into the curriculum, I designed an exercise on Autonomic Pharmacology that includes a group exercise on identifying four different "ANS drug unknowns" based upon how they modify blood pressure responses to various agonists (ACh, NorEpi, Epi, isoproterenol, tyramine) and CV maneuvers (vagal stimulation, double carotid occlusion). I also worked with clinical colleagues over the following year to develop TBL exercises on treatment of diabetes, coagulation disorders, and heart failure. In general, replacement of didactic lectures with TBL exercises increased exam performance (internal exams & NBME standardized exams) significantly (but only by a few percent). The most marked improvement was seen in students whose grades are below the class mean (who seem to benefit the most from active learning exercises, in general).

Related Educational Presentations & Workshops:

- Daniel A, Crawford B, Krane K, Kahn M, Clarkson C, Dise T, Klingsberg R. Workshop: A Team Approach to Implementing Team-based Learning: Lessons Learned. April 3, 2009. Abstract #228 Southern Group on Education Affairs (SGEA), New Orleans
- Kahn M, Clarkson C, Crawford B: Coagulation Team Based Learning Exercise. MedEdPORTAL. AAMC #4054 6/30/2009.
- Ficarra M, Crawford B, Clarkson C, Barrett D, Gibson J: Assessment of Learning in TBL Educational Sessions. IAMSE Annual Meeting, Poster presentation, July 10, 2010.

Human Patient Simulation:

Three METI Human Patient Simulations were developed and implemented for our 2nd year medical class in 2009-2010, shortly after the opening of the Tulane Simulation Center.

The first simulation designed was focused on the diagnosis & treatment of unstable angina & cardiac arrhythmias using the adult METI Human Patient Simulator. The outline for the simulation (case history & story line) was developed by Drs Krane, LeDoux and I. Using the case outline, I developed a METI HPS scenario to emulate the patient's presenting heart rate & blood pressure, and a METI scenario for simulating the onset of unstable angina with ST segment depression & associated changes in heart rate & blood pressure. The simulation included responses to drug administration (nitroglycerin, morphine, oxygen, metoprolol), simulation of various arrhythmias (bradycardia, AV block, VTach, VFib) and treatments (Cardioversion/Defibrillation, amiodarone, lidocaine & atropine). Dr. LeDoux played the role of the ER physician, and I coordinated the simulation via a laptop computer from a control room behind a one-way mirror & played the voice of the patient "Mr. Boudreaux".

A second simulation was on the diagnosis & treatment of severe bronchoconstriction in a pediatric patient (using the 6 yo METI Human Patient Simulator). The objectives of this simulation were focused on students being able to work as a team to get the patient's history from a parent (played by a simulation staff member with a Theatre background), assess the patients status (BP, HR,RR, O2 Sat, Lung Sounds), make a diagnosis & apply treatment in the right order (O2, beta-2 agonist, steroid), followed by reassessment & ultimately "handing off" the patient to an attending physician (Scott Davis, MD - pediatrician). The simulation exercise was followed by a 30-45 min debriefing by Dr. Scott Davis. I coordinated the simulation via a laptop computer & played the voice of the patient "Wheezing Willy".

A third simulation on the treatment of severe pain was developed for the Neurology block. This simulation developed involved "Mr Tibideaux" (an alcoholic with a history of stomach ulcers) who was the victim of a gun shot wound to the leg while in a local bar. He also suffered a laceration of the area around his eye from a piece of flying glass. In the Emergency department he is evaluated by the ER physician and students. As the scenario evolves he is given morphine (vs ketorolac), suffers a morpine overdose, requires naloxone. When his eye is examined, eye pressure produces a severe bradycardia, requiring treatment with atropine. A discussion of treatment options, side effects, and drug interactions is easily covered as the scenario develops. Developed with Dr. Elma LeDoux.

To assess the educational impact of active participation in Simulation exercises, in 2011 we compared the scores obtained on two block exams for questions that were related to concepts addressed to the Sim sessions (but were also covered in lecture or self studies), vs exam scores on questions unrelated to the Sim exercises. Scores were compared for students who were present for the Sim exercise, vs those who were absent. As shown below, those who were inside the ER room during the Sim exercises significantly outperformed those who were absent, even though the same material being tested on was covered in previous lectures. A similar difference was not seen between the two groups for other exam questions. As a result, we made attendance of Sim sessions "mandatory" in the years that followed (mandatory meaning that students are given points for attendance & participation).

Outcomes: Exam Performance

A. Angina / Cardiovascular:

	7 Sim-Related Qs:		110 Non-Sim-Related Qs:	
Inside ER (n=100):	90.7±1.3	P=0.037	84.2±0.8	NS (P=0.12)
Absent (n=44):	85.4±2.5		82.1±1.4	

B. Asthma / Pulmonary:

	6 Sim-Related Qs:		93 Non-Sim-Related Qs:	
Inside ER (n=50):	85.0±1.8	P=0.033	83.4±1.2	NS (P=0.18)
Absent (n=81):	78.2±2.2		81.2±0.9	

Conclusion:

The Inside ER Group significantly outperformed the Absent Group on Simulation-related questions, but not on Non-Simulation related exam questions.

Related Educational Presentations & Workshops:

- *Using Human Patient Simulators to Enhance Basic Science Education Throughout the Undergraduate Medical Curriculum*. IAMSE Faculty Development Course, July 10, 2010. Susan Pasquale, John L Szarek, Elma LeDoux, Craig W Clarkson. Tulane University.
- *It's About the Science: The Art and Science of Using Human Patient Simulators to Enhance Basic Science Education*. S Chauvin, C W Clarkson, J Szarek, R Ten Eyck. Podium Presentation #608. Society for Simulation in Healthcare (Annual Meeting, New Orleans) 1/25/11.

Medical Wikis & Interactive Self-Assessment Quizzes (Pharmwiki):

Over the past 7 years I have been developing an interactive Pharmwiki for our Medical curriculum that is designed to provide a "one stop shopping" information & learning resource for our medical & graduate students. It contains:

- Essential drug information with cited references (e.g. Original articles, Katzung's Pharmacology text, Harrison's Internal Medicine)
- Case-based learning modules on 19 different topics that summarize:
- disease pathophysiology
- patient signs & symptoms
- clinical diagnosis
- treatment options
- Interactive formative assessment quizzes (on **46 topics, 750 questions**)

The Pharmwiki resource is intended to explain different systems-based topics in pharmacology topics, whenever possible in their appropriate "clinical context" in order to provide "mental scaffolding" to promote long-term retention & understanding of pharmacology. The primary philosophy in the design of Pharmwiki has been to be "correct, concise & clear". Pharmwiki has heavily emphasized the use of interactive self-assessment quizzes because educational research (conducted at different levels, from middle school to post-graduate medical education) has shown that taking frequent quizzes provides a form of "mental retrieval practice" that can produce a better recall of facts and a deeper understanding compared to an education devoid of self assessment (Dobson, 2008; Karpicke & Roediger, 2008; Logan et al, 2011; McDermott et al, 2014; Reed et al, 2014; Paul, 2015). As shown below, a 2011 survey of 2nd year medical students indicated that Pharmwiki was the #1 primary information resource for students taking Medical Pharmacology.

Pharmwiki url: http://tmedweb.tulane.edu/pharmwiki/doku.php/

3. What did you primarily use as an information resource?			
		Response Percent	Response Count
Tegrity (lecture capture audio/video)		8.0%	12
Class notes		8.0%	12
Handouts		2.0%	3
Textbook		1.3%	2
PharmWiki		80.0%	120
Other		0.7%	1
		answered question	150
		skipped question	0

Related Educational Presentations & Workshops:

- Wikis and Interactive Quizzes - Technology Our Students Really Use to Learn. Clarkson CW.Tulane School of Medicine Educational Technology Retreat, May 1, 2012.

GRADUATE EDUCATION:

Director of Graduate Studies in Pharmacology &
Resurrection of Our Graduate Curriculum After Katrina:

In December 2005, while I was living in Houston following Katrina, my chairman placed me in charge of our department's doctoral and masters graduate programs. At the time of the storm we had 40 masters students and ~12 doctoral students in the pharmacology graduate program. When classes resumed at the New Orleans downtown campus in mid-January of 2006, we had 25 masters students return, along with ~ 6 doctoral students. During several trips back from my duties at Baylor, I found rooms (with acceptable air quality) that we could use for teaching in portions of the 1430 Tulane Ave building, although we tried to use the Gene Therapy conference room in the JBJ building whenever it was available. With limited access to classrooms & a reduced number of available faculty, I heavily revised our graduate curriculum, so that we could complete all previously scheduled graduate classes for the 2005-06 academic year during the Spring semester of 2006 & an extra Summer lagniappe semester in

June-July of 2006. One component of this challenge was to find a way to simultaneously teach our complete Medical Pharmacology course at both the New Orleans campus (to our doctoral & masters students) & Baylor campus (to our medical students). Lectures on the two campuses had to be scheduled out of sync with each other, since our remaining teaching faculty could not be in two places at once. This was not a fun year.

Development of a Thematic & Objective-Based Graduate Curriculum (2006-07):

During the summer of 2006, in response to student criticisms about our graduate curriculum, I made a series of major changes to our department's graduate curriculum. These changes were based upon a "proven" design – that of our 2nd year medical curriculum which I had been involved with designing over the previous decade:

- I rearranged our traditional graduate curriculum to replace it with a thematic "organ-system" based design in which (as much as possible) all lectures in all graduate courses covered the same theme being covered in Medical Pharmacology. This included topics covered in our seminars & weekly journal club. This change was designed to re-inforce student learning.
- With the help of our faculty, a list of specific learning objectives was developed for each graduate lecture given in our two primary graduate courses: Principles of Pharmacology & Pharmacology Research. Exams were designed to cover the material outlined in the learning objectives.
- Graduate exams were placed at the end of each Med Pharm "thematic block".
- Lecture handouts, containing learning objectives, were collated prior to each thematic block & distributed ahead-of-time to students. This allowed students to prepare for lectures ahead of time.
- Audio recordings of graduate lectures were initiated in the Fall of 2006 and a Graduate Resources website was developed that included the new thematic lecture schedule, and a media website was designed to provide links to down-loadable versions of all lecture audio recordings & lecture slides (html & pdf versions). One of my new duties became the development, maintainance & archieving of this website. During the 2008-09 academic year, we switched to use of the Tegrity Classroom recording system for graduate lectures, and then in 2014 we switched to using Mediasite.
  Graduate Resources Website url: http://tulane.edu/som/departments/pharmacology/gradresources/index.cfm

Related Educational Presentation:

- *The Doctoral Program in Pharmacology at Tulane University – Post Katrina.* Meeting of the National Directors of Graduate Studies in Pharmacology (Salt Lake City, Utah, July 25-28th, 2007)

Systems Biology Course Directorship (2008-2012):

The Systems Biology Course was a newly constructed course, first offered in Spring 2007 for the 1st year doctoral students in our newly created umbrella "Biomedical Sciences" (BMS) doctoral program. Although this course looked great "on paper", it received some "negative" reviews in its end-of-course

survey. The major criticisms of the course included: a) some lectures were excessive in length (90+ slides), b) there was excessive redundancy & duplication of material covered in different lectures, c) there was no communication between lecturers, d) no class notes were available before lecture, e) there were too many details to be remembered for exams, and f) there were not enough exams (e.g. 2 exams was not enough).
In the Summer of 2007, I was asked by my chairman to take over as course director. After reviewing the survey results, I implemented a number of changes to address the concerns raised. These included:

- Development of a course website where all lecture slides are posted in html & pdf formats (url below). This allowed myself, other faculty & students easy access to the course content. This facilitated the discovery & elimination of excessive redundancy & lecture length, prior to when classes begun in Spring of 2008.
- Development of learning objectives for all lectures. These were posted on the course web site & are printed on the front cover of every lecture handout.
- Redesign of the course schedule to include a 3rd exam. Each of the progress exams covers 7, 7 & 9 lectures, respectively. Exam questions are based upon the stated lecture learning objectives, so as to level the playing field of what students "need to know".
- Creation of a course syllabus (collection of handouts & lecture schedule), collated, printed & distributed prior to each block of lectures.
- With the assistance of Jeanne Samuel in our Office of Medical Education, we developed an online survey – feedback form (linked to from the course website) where students can provide anonymous feedback on individual lectures and exams.

For the 2009 academic year I made some additional adjustments to the course including:

- streamlined the course content to focus in more depth on cardiovascular physiology & pharmacology
- converted lectures to a 1 hr format (vs. "killer" 1.5 hr lectures), 3 lectures per week
- increased the number of exams to 5 total.
- introduced the use of the Audience Response System for my 3 hrs of lecture. The use of the system was offered to other faculty.
- began using Blackboard (MyTulane) as the Course Management System for lecture media, email communication & posting of grades

Concepts in Pharmacology Course Directorship (2008 pilot project):

To facilitate the development of active learning strategies in our graduate curriculum, I developed a 1 credit hour "pilot" course for our Masters in Pharmacology students. The course consisted of seven JiTT sessions that had a pre-class reading assignment, a pre-class Bb quiz, and a class session focused on interactive ARS questions, including 3 questions at the end of each class session using the Peer Instruction method. The course grade was based upon performance on Bb quiz questions, and Peer Instruction questions. An end of course survey indicated a high level of student satisfaction, with a 4.6 out of 5 rating for "This course enhanced my learning" (1-5 scale).

Graduate Thesis Committees

Masters Thesis Committees – (2006-2007 example)

- Bradley Blasair (Leraphanol & NMDA receptor effects on chronic pain)*
- Aaron Boonjindasup (MSC's in the repopulation of cardiomyocytes)
- Dorothy Contiguglia (Gingko Biloba in Alzheimers)*
- Dustin Hill (Somatostatin Receptor expression in activated Lymphocytes)
- Donald Iocco (Synergistic Drug Effects of Nicotine & Stimulants)
- Chanakaya Jandhyala (Disruption of P-selectin after IRI tissue injury)
- Patrick Lang (Inhaled insulin for diabetes)*
- Edward Mannina (Antibodies for treatment of Cancer)*
- Gregor Manukian (Hyperbaric Oxygen after Ischemic / Reperfusion injury)
- Ehsan Mozayan-Isfanahi (NPY & its pro - & anti-nociceptive effects)
- Megan Stock (NMDA receptor antagonists & Neuropathic Pain)
- Brian Talleur (CV dysfunction with Diabetes)
- Carolyn Tejirian (NO synthetase inhibitors for Migraines)
- Lisa To (DES & estrogenic disruption)
- Megha Upadhyaya (Environmental Factors Underlying the Pharm of Autism)*
- Julie Williams (Drugs of abuse testing methodologies)

* Thesis advisor for these 5 students

Doctoral Thesis Committees

▪ William Crumb Jr. (Pharmacology)	1988-1991 (Ph.D. thesis advisor)
▪ Nick Ferencz (Pharmacology)	1988-1991
▪ Jeff McGee (Physiology)	1989-1992
▪ Chu Chen (Physiology	1991-1993
▪ Owen Wilson (Physiology)	1992-1994
▪ Conrad Mallia (Pharmacology)	1991-1995
▪ Etoi Garrison (Pharmacology)	1994-1995
▪ Victor Ruiz (Physiology)	1992-1995
▪ Jose Santiago (Pharmacology)	1992-1995
▪ Ingrid Ehrlich (Physiology)	1994-1996
▪ Alan Kaye (Pharmacology)	1991-1997
▪ David Lambert (Pharmacology)	1996-1998
▪ Neviana Nenova (Pharmacology)	1994-1998 (Ph.D. thesis advisor)
▪ Walter Robertson (Physiology)	1994-2000
▪ Christopher Holt (Pharmacology)	1996-2000
▪ Hunter Champion (Pharmacology)	1996-1999
▪ Adam Hendricson (Pharmacology)	1999-2001
▪ Hoya Lang (Physiology)	1999-2001
▪ Christopher Williams (Pharmacology)	1999-2004
▪ Juan Guo (Physiology)	2000-2001
▪ Leena Pradhan (Pharmacology)	2001-2004

- Steve White (LSU Biochemistry) 2001-2005
- Trinity Bivalacqua (Pharmacology) 2002-2004
- James T. Taylor (Pharmacology) 2002-2005
- Brian Keyser (Pharmacology) 2002-2005
- John Liles (Pharmacology) 2002-2005
- Allison Intondi (Pharmacology) 2005-2007
- Anthony (Joel) Greco (MCB) 2004-2008
- David Casey (Pharmacolgy) MD/PhD 2006-2011
- Jim Antoon (Pharmacology) MD/PhD 2007-2010
- Daniel Petroni (Pharmacology) MD/PhD 2007-2011
- Jonathan Pottle (Physiology) 2009-2012

EDUCATION-RELATED SYMPOSIA LECTURES & WORKSHOPS:

- *The Doctoral Program in Pharmacology at Tulane University – Post Katrina.*
  Meeting of the National Directors of Graduate Studies in Pharmacology
  (Salt Lake City, Utah, July 25-28th, 2007)
- *Integrating Web 2.0 Technologies into the Curriculum*
  Clarkson CW, Samuel J, Daniel A. Medical Education Workshop presented April 5, 2008
  Southern Group on Education Affairs (SGEA), Vanderbilt University.
- *A Team Approach to Implementing Team-based Learning: Lessons Learned*
  Daniel A, Crawford B, Krane K, Kahn M, Clarkson C, Dise T, Klingsberg R.
  Small group discussion. April 3, 2009. Abstract #228 Southern Group on Education Affairs (SGEA), New Orleans
- *Active Learning & Learner-Centered Instruction. Changing the Emphasis from Teaching to Learning.*
  Meeting of the National Directors of Graduate Studies in Pharmacology
  (New Orleans, LA, April 23rd, 2009)
- *Small group workshop on Active Learning* - National Directors of Graduate Studies in Pharmacology
  (New Orleans, LA, April 23rd, 2009)
- *Active Learning* - Robert Glaser Teaching Award (Post-dinner talk). Alpha Omega Alpha Medical Honor Society
  (New Orleans, LA, April 22nd, 2009)
- *Just-in-Time-Teaching & Classroom Response Systems. Changing the Emphasis from Teaching to Learning.* Annual Meeting of the Group for Research in Pathology Education (GRIPE), Jan 15, 2010. New Orleans, LA.
- *Using Human Patient Simulators to Enhance Basic Science Education Throughout the Undergraduate Medical Curriculum*. IAMSE Faculty Development Course, July 10, 2010. Susan Pasquale, John L Szarek, Elma LeDoux, Craig W Clarkson. Tulane University.
- *It's About the Science: The Art and Science of Using Human Patient Simulators to Enhance Basic Science Education*. S Chauvin, C W Clarkson, J Szarek, R Ten Eyck. Podium Presentation #608. Society for Simulation in Healthcare (Annual Meeting, New Orleans) 1/25/11.
- *IAMSE Workshop on Just-in-Time-Teaching in Medical Education.*Clarkson CW, Franklin, D International Asson. of Medical School Educators (IAMSE) Meeting, Portland OR, June 25th, 2012.

- *Wikis and Interactive Quizzes - Technology Our Students Really Use to Learn.* Clarkson CW.Tulane School of Medicine Educational Technology Retreat, May 1, 2012.

EDUCATION-RELATED PUBLICATIONS:

- Britt M, Clarkson CW, VIgh S, Robichaux W, Bowdish BE, Chauvin S: Utilizing Adobe Acrobat to deliver diverse educational materials (abstract/poster presentation). Southern Group on Educational Affairs. 1998 Annual Meeting, New Orleans, LA. Poster #2.
- Franklin DS, Gibson JW, Samuel JC, Teeter WA, Clarkson CW: Use and benefits of lecture recordings in medical education. Southern Group on Educational Affairs. 2009 Annual Meeting, New Orleans, LA. Poster/Abstract #233.
- Clarkson CW, Agrawal KC, Mondal D: Peer instruction enhances student performance on pharmacology quizzes. Southern Group on Educational Affairs. 2009 Annual Meeting, New Orleans, LA. Abstract/Poster #249.
- Kahn M, Clarkson C, Crawford B: Coagulation Team Based Learning Exercise. MedEdPORTAL. AAMC #4054 6/30/2009.
- Ficarra M, Crawford B, Clarkson C, Barrett D, Gibson J: Assessment of Learning in TBL Educational Sessions. IAMSE Annual Meeting, Poster presentation, July 10, 2010.
- Franklin DS, Gibson JW, Samuel JC, Teeter WA, Clarkson CW: Use of lecture recordings in medical education. Med Sci Educator 21(1): 21-28, 2011.

EDUCATIONAL COURSEWARE:

Instructional **DVDs Developed during the 2003-05 Academic Years:**

- Adrenergic & Cholinergic Pharmacology
- ANS Unknown Drug A (Atropine)
- ANS Unknown Drug B (Phentolamine)
- ANS Unknown Drug C (Cocaine)
- ANS Unknown Drug D (Hexamethonium)

Problem Based Learning Modules Co-authored:

- Clarkson CW, LeDoux EI, Moudgil GC, Hyman A: Mr. Dicky Heart, A PBL Exercise on Cardiac Pathophysiology & Antiarrhythmic Pharmacology.
- Clarkson CW, Guth PS, Taylor B: Chemical Warefare (in Iraq) PBL
- Lottinger RG, Beckman BS, Clarkson CW: Hormonal Contraception PBL.
- Kadowitz PJ, LeDoux EI, Clarkson CW: Hypertension PBL

Pharmwiki (2009 - present)

- url: http://tmedweb.tulane.edu/pharmwiki/doku.php/

References on Formative Assessment Quizzes in Adult Learning:

1. Dobson JL (2008): The use of formative online quizzes to enhance class preparation and scores on summative exams. Adv Physiol Educ 32(4): 297-302.

2. Karpicke J. D., Roediger H. L., III (2008): The critical importance of retrieval for learning. Science. 319:966–968.
3. Logan JM et al (2011): Testing to enhance retention in human anatomy. Anat Sci Educ 4(5):243-8.
4. McDermott KB et al (2014): Both multiple-choice and short-answer quizzes enhance later exam performance in middle and high school classes. J Exp Psychol Appl 20(1):3-21.
5. Palmen LN et al (2015): What is more effective: a daily or a weekly formative test? Perspect Med Educ 4(2): 73-8.
6. Paul AM (Aug 1, 2015): Researchers Find That Frequent Tests Can Boost Learning. Scientific American.
7. Reed S et al (2014): Applying adult learning practices in medical education. Curr Probl Pediatr Adolesc Health Care 44(6):170-81.

SECTION 3: PHILOSOPHY OF TEACHING & LEARNING

"First, interactive teaching has been demonstrated to lead to considerably larger teaching gains. Second, after an instructor has been exposed to the feedback this method of teaching affords, it is impossible to go back to the passive lecture format and remain ignorant about what goes on in the minds of students"

Eric Mazur PhD, Harvard University[1]

When I was a young assistant professor ~24 years ago, my philosophy of teaching was to imitate the teaching style of one of my highly respected former mentors at the UCSF. Before leaving California for New Orleans I had tape-recorded several of his lectures on topics that I knew I would have to give at Tulane. I'd do my best to imitate his approach, and would practice giving a lecture 5 or 6 times (out load in my office) before I would give a lecture for the first time. While these lectures were as "interactive" as I could make them, this style of instruction resulted in more passive learning than I now find acceptable. Several personal experiences combined with a desire to learn what "the best teachers do" resulted in a transformation in how I prefer to teach.

One of these experiences occurred many years ago when I was fortunate enough to have been able to spend 5 years training & then teaching at Frank Michael's Taekwondo School in Kenner. Mr. Michael (6th Degree), who is one of the most motivational teachers I have ever met, drummed it into our heads that an instructor's role is to be their student's "success coach".2 Our goal was to do everything we could to motivate, observe & guide students so that they succeeded in passing their next belt test. This is a teaching style that is completely "learner-centered". This philosophy meshed well with my own sense of purpose as a course director.

I view my primary role as a course director is to find ways to help students succeed and excel. I do my best to provide our students with up-to-date & accurate information, give them advice about what I think the "most clinically important" concepts are, and provide them with various forms of assessment – including interactive online quizzes that provide constructive feedback when they make an incorrect choice. I promote regular group study, because I have observed the positive outcome of peer discussion in enhancing the understanding of clinically relevant problems. I believe, as do most educational specialists, that adults learn more effectively when they are engaged in their own learning, can relate to the material they are being asked to learn, and find personal value in what they are being asked to learn. The art of instruction is to find ways of communicating with & motivating students so that these goals are achieved.

Related to this goal, I have recently begun using two teaching strategies, "Just-in-Time-Teaching" & "Peer Instruction"3 to foster interactive engagement of students in the classroom. When these strategies are applied, students come to class prepared with a basic understanding of the topic to be discussed, and the instructor knows the areas of student difficulty, based upon responses to a graded pre-class essay question completed online the night before. This allows class time to focus on areas of greatest educational impact - areas of student difficulty & major concepts, rather than having to "cover"

a ton of content. With the use of a Classroom Response System, and well-constructed USMLE-style questions, class time can be devoted to helping students clarify misconceptions, and learn how to apply knowledge to clinical situations. Pausing to have students debate which answers are "best" using a peer instruction format rapidly enhances student understanding, and the feedback provided by this style of instruction lets both the student and the instructor know how well they are "getting it", instead of waiting until they take a block exam only to learn they have failed. Class time becomes a more "high yield" experience as compared to an hour of passive note taking.

I also believe that in the 21st century, learning can be enhanced by providing online resources that can be accessed from any location with a connection to the internet. In support of this belief, I have developed a large database of interactive quizzes that students can use for formative assessment prior to taking a block exam. I am also collaborating with Harvard Medical School's Medpedia project to develop a wiki database on "concepts in medical pharmacology" that will help identify major concepts in different system-related topics, and to provide examples of clinical problems demonstrating the application of these concepts. The goals of this project are to aid the learner in knowledge construction, critical thinking, problem solving & contextual learning in an interactive environment.

References:

1. Eric Mazur's forward of the book by Douglas Duncan *Clickers in the Classroom*. Pearson-Addison-Wesley, San Francisco CA, 2005.
2. While this may sound like a somewhat corny philosophy to some, it really isn't when you consider that keeping students motivated & successful is important for promoting a teenager's self esteem, as well as keeping tuition-paying students enrolled in your school!
3. These are teaching strategies originally invented in the early 1990's for teaching undergraduate Physics (see references 4 & 5 below).
4. Crouch CH and Mazur E: Peer instruction: ten years of experience and results. Am J Physics 69:970-977, 2001
5. Novak GM, Patterson ET, Gavrin AD, Christian W. Just-in-Time-Teaching: Blending Active Learning with Web Technology. Prentice Hall, Upper Saddle River, NJ. 1999. (ISBN 0-13-085034-9) (Online version of JiTT)

SECTION 4: EDUCATIONAL RESPONSIBILITIES

Course Director Positions:

- Medical Pharmacology (2nd year medical course) 1997-present
- Advanced Topics in Cardiovascular Pharmacology (Graduate) 2000-present
- Systems Biology (BMS Doctoral Program) 2007-present
- Concepts in Pharmacology (Masters program) 2008-2009
  (pilot project involving active learning in grad education)
- Principles of Pharmacology (Graduate; co-director) 2010-present
- Pharmacology Research Methods (Graduate) 2010-present
- Pharmacology ePortfolio (Graduate) 2011-present

Graduate Teaching:

- Principles of Pharmacology: Cardiac Physiology & Cardiac Arrhythmias (4hrs)
- Advanced Topics in Cardiovascular Pharmacology (2 hrs/week, Spring Semester)
  This course is a structured journal club, taken by MS & PhD students; a T2 elective
- Pharmacological Research: Whole Animal Electrocardiography (2hrs)
- Principles of Pharmacology – LSU Med Center: Ion Channels (1 hr)
- Advanced Cell Biology (BMS PhD program):Membrane transporters & mitochondrial function (1.5 hrs)
- Systems Biology (BMS PhD program):Drug Receptor Theory (1 hr) & Cardiac Physiology (2 hrs)
- Concepts in Pharmacology (MS program) - a one semester pilot project Fall 2008. We gave Just-in-Time-Teaching (JiTT) sessions with Peer Instruction on the following topics:

  - Principles of Pharmacology
  - Antimicrobial Drugs *
  - Rx of HIV *
  - Cancer Chemotherapy *
  - Autonomic Pharmacology
  - Treatment of Asthma
  - Rx of Hypertension

  * team taught with Dr. Mondal or Agrawal

  An end of course survey indicated a high level of student satisfaction, with a 4.6 out of 5 rating for “This course enhanced my learning” (1-5 scale). The teaching & learning methods developed & refined in this pilot course were then incorporated into other courses in the graduate & medical curriculum, including Principles of Pharmacology & Medical Physiology during the 2009-2010 academic year

Medical Teaching:

Medical Physiology (T1) - Lectures & JiTT Sessions

- Principles of Cardiac Excitation & Contraction (2hrs) - JiTT
- Introduction to the electrocardiogram
- Cardiac Arrhythmias - Mechanisms & ECG Interpretation (2 hrs) - JiTT

Medical Pharmacology (T2) – Lectures

- Course Introduction
- Pharmacokinetics (2 hrs)
- Cholinolytic Drugs
- Hepatic Drug Clearance
- Antianginal Drugs
- Drugs used in Rx of Asthma
- General & Local Anesthetics
- Adjunct drugs used in Anesthesiology
- Sedative / Hypnotic / Anxiolytics
- Antipsychotics
- Psychostimulants, Drugs of Abuse
- Drug Responses in Children, Women & the Elderly
- Herbal Drugs
- Drug Interactions

Medical Pharmacology (T2) – Just-in-Time-Teaching Sessions

- Basic Principles of Medical Pharmacology
- Antiarrhythmic Drugs (2 hrs)
- Digitalis Glycosides
- Vasodilators in the treatment of CHF
- Antidepressants, MAO inhibitors & Li

Helped develop & facilitate additional JiTT sessions on:

- Glucocorticoids (w/ Dr. Beckman)
- GI Drugs (Beckman)
- Penicillin Antibiotics (w/ Dr. Agrawal)
- Cancer Chemotherapy (w/ Dr. Agrawal)

Medical Pharmacology (T2)– Block Reviews

- Basic Principles & Rx of Inflammation (1 hr)
- ANS & CV Pharmacology (1.5 hrs)
- Renal Block (1 hr)
- CNS Drugs (1.5 hrs)
- Human Behavior block (1.5 hrs)
- Endocrine & Toxicology Block (1.5 hrs)

Medical Pharmacology (T2)- Team Based Learning

- Rx of Venous & Pulmonary Thrombosis - w/ Drs. Kahn & Crawford

- Autonomic Unknowns
- Diabetes (with Drs. Beckman & Jennifer John-Kalarickal)
- Heart failure (with Dr. Elma LeDoux)
- Thyroid Disorders (under development w/ Drs Beckman & John-Kalarickal)

Medical Pharmacology (T2)- Problem Based Teaching

- Drug Metabolism & Drug Interactions
- Adrenergic/Cholinergic In Vivo Demonstration
- Antibiotics - Clinical Problem Solving
- Chemical Warfare in Iraq
- Hypertension
- Antiarrhythmic Drugs - Clinical Problem Solving
- Treatment of Diabetes Mellitus – Clinical Problem Solving (Graduate)
- Oral Contraceptives – Clinical Problem Solving
- Treatment of Depression – Clinical Problem Solving

Medical Pharmacoogy (T2) METI Human Patient Simulation Exercises (~35 hrs)

- ***Mr Boudreaux -*** *Diagnosis & treatment of unstable angina & cardiac arrhythmias*(an exercise developed in collaboration with Elma LeDoux MD - Director of Clinical Diagnosis)
- ***Willie Wheezer -*** *Diagnosis & treatment of severe pediatric bronchoconstriction* (an exercise developed in collaboration with Scott Davis MD - Director of Pediatric T3/T4 Clerkship)

Education Related Committees:

University or Medical Center

- Academic Computing 1988-1993
- Surgery Required Clerkship Review Committee 1991-1993
- Admissions Committee 1994-1999, 2005-present
- Senate Committee on Honors 1997-1999
- Graduate Council 1997-2000
- University Senate Commitee on Computing 1998-2001
- Curriculum Committee 1999-2007, 2009-present
- 2nd Year Clinical Curriculum Advisory Committee 1997-present
- Evaluation Committee (under Dr. Markert in OME) 2004-2005
- MECCA Committee (Medical Education) 2000-2001
- Student Affairs Committee (chair) 2004-present
- Scope Advisory Committee 2004-2005
- Educational Technology Committee (chair) 2007- present
- Evaluation & Assessment Committee – SOM 2008-present
- Simulation Curriculum Committee 2008-present
- Simulation Research Committee 2010-present
- Educational Policy Committee (Univ Senate) 2009-present
- Pharmacology Dept Curriculum Comm (chair) 2009-present

- Pharm Dept Med Pharm Course Comm (chair) 2009-present

Masters Thesis Committees – (2006-2007 example)

- Bradley Blasair (Leraphanol & NMDA receptor effects on chronic pain)*
- Aaron Boonjindasup (MSC's in the repopulation of cardiomyocytes)
- Dorothy Contiguglia (Gingko Biloba in Alzheimers)*
- Dustin Hill (Somatostatin Receptor expression in activated Lymphocytes)
- Donald Iocco (Synergistic Drug Effects of Nicotine & Stimulants)
- Chanakaya Jandhyala (Disruption of P-selectin after IRI tissue injury)
- Patrick Lang (Inhaled insulin for diabetes)*
- Edward Mannina (Antibodies for treatment of Cancer)*
- Gregor Manukian (Hyperbaric Oxygen after Ischemic / Reperfusion injury)
- Ehsan Mozayan-Isfanahi (NPY & its pro - & anti-nociceptive effects)
- Megan Stock (NMDA receptor antagonists & Neuropathic Pain)
- Brian Talleur (CV dysfunction with Diabetes)
- Carolyn Tejirian (NO synthetase inhibitors for Migraines)
- Lisa To (DES & estrogenic disruption)
- Megha Upadhyaya (Environmental Factors Underlying the Pharm of Autism)*
- Julie Williams (Drugs of abuse testing methodologies)

* Thesis advisor for these 5 students

Doctoral Thesis Committees

- William Crumb Jr. (Pharmacology) 1988-1991 (Ph.D. thesis advisor)
- Nick Ferencz (Pharmacology) 1988-1991
- Jeff McGee (Physiology) 1989-1992
- Chu Chen (Physiology) 1991-1993
- Owen Wilson (Physiology) 1992-1994
- Conrad Mallia (Pharmacology) 1991-1995
- Etoi Garrison (Pharmacology) 1994-1995
- Victor Ruiz (Physiology) 1992-1995
- Jose Santiago (Pharmacology) 1992-1995
- Ingrid Ehrlich (Physiology) 1994-1996
- Alan Kaye (Pharmacology) 1991-1997
- David Lambert (Pharmacology) 1996-1998
- Neviana Nenova (Pharmacology) 1994-1998 (Ph.D. thesis advisor)
- Walter Robertson (Physiology) 1994-2000
- Christopher Holt (Pharmacology) 1996-2000
- Hunter Champion (Pharmacology) 1996-1999
- Adam Hendricson (Pharmacology) 1999-2001

- Hoya Lang (Physiology) 1999-2001
- Christopher Williams (Pharmacology) 1999-2004
- Juan Guo (Physiology) 2000-2001
- Leena Pradhan (Pharmacology) 2001-2004
- Steve White (LSU Biochemistry) 2001-2005
- Trinity Bivalacqua (Pharmacology) 2002-2004
- James T. Taylor (Pharmacology) 2002-2005
- Brian Keyser (Pharmacology) 2002-2005
- John Liles (Pharmacology) 2002-2005
- Allison Intondi (Pharmacology) 2005-2007
- Anthony (Joel) Greco (MCB) 2004-2008
- David Casey (Pharmacolgy) MD/PhD 2006-present
- James Antoon (Pharmacology) MD/PhD 2007-present
- Daniel Petroni (Pharmacology) MD/PhD 2007-present
- Jonathan Pottle (Physiology) 2009-present

SECTION 5: CURRICULUM DEVELOPMENT & INNOVATION

Medical Education Involvement & Reform:

I have been the course director for the 2nd year Medical Pharmacology course since 1997. This is a team-taught course consisting of ~100 contact hours and 11 exams. I am responsible for teaching ~25% of course content and I am involved with all small group teaching & most review sessions. For the past decade I have worked with other course directors to transform the 2nd year curriculum from a traditional curriculum where each course is taught independently (and out of sync), into a more learner-centered curriculum where the content in different courses (e.g. pathology, clinical diagnosis, microbiology, pharmacology) is taught in a highly coordinated thematic manner (by disease & organ system).

Fostering Objective-Based Learning & Assessment:

At the end of the 1997-98 academic year a survey by the student honor society (Owl Club) concluded "56.6% of students felt that exams did not effectively assess the information presented." In response to these complaints I initiated (with the help of my faculty!) the development of learning objectives for every contact hour & self study, as well the construction of new block exams that emphasized these objectives. Over the years I have also developed a series of 39 on-line interactive quizzes with over 500 questions (most in USMLE format). These quizzes provide students with the opportunity for a rigorous self-assessment before taking block exams that affect their grade.

Development of Problem Based & Team Based Learning:

Over the past decade I have worked with colleagues to develop case-based Problem Based Learning (PBL) sessions, and I am the senior author on 4 out of 8 of the PBL sessions used in our Med Pharm course. During the 2008-09 academic year I helped develop two Team-Based-Learning (TBL) sessions on coagulation disorders & autonomic pharmacology. In TBLs students complete an assigned reading before class, and during the session work as members of a team (of 6 students) to solve clinically relevant problems. Both PBL and TBL sessions foster active learning, the development of interpersonal skills and learning pharmacology in a clinical context, which are approaches that are believed to enhance long term retention (as compared to wrote memorization of facts).

Helping to Resurrect Tulane Med School at Baylor after Katrina:

In the Fall of 2005, following hurricane Katrina, the Baylor College of Medicine very generously invited Tulane to utilize their physical facilities & support staff to keep our Medical School open for the remainder of the 2005-06 academic year (in Houston). I relocated there in mid-September with a core group of administrators, faculty & course directors to organize and deliver a 1st & 2nd year medical curriculum using a mixture of faculty from Baylor, MD Anderson & Tulane. We lost 4 weeks of curricular

time during the initial chaos. We also lost 1/3rd of our teaching faculty in December 2005 due to University mandated "faculty separations" related to financial exigency, so some of us suddenly found ourselves faced with new teaching responsibilities. The medical class relocated back to New Orleans in the summer of 2006 after repair of its buildings were nearly complete. There were many lessons learned during our "Baylor experience", including how generous Baylor & Texans in general, can be.

Development of Interactive Quizzes & Wiki for Formative Assessment & Contextual Learning

To provide additional student resources for formative assessment, I have developed a large database of interactive quizzes (over 500 questions on 39 different topics) that students can use for self-assessment prior to taking block exams. Recently I have begun working as a contributing editor for Harvard Medical School's Medpedia project to develop a wiki database on "concepts in medical pharmacology" that will help students identify major concepts in different system-related topics. This wiki, with which students can actively edit & participate, will also provide examples demonstrating the application of these concepts in a clinical context. The goals of this project are to aid students in knowledge construction, critical thinking, problem solving & contextual learning in an interactive environment.

Developing Online Lecture Media as a Learning Resource:

In a collaborative project initiated by one of our (then) 1st year medical students (Niels Olson - class of 2009), we began making audio recordings of 2nd year Medical Pharmacology & Mechanisms of Disease lectures & posting both the audio recordings & lecture slide sets on a restricted server in the Fall of 2006. This became a wildly popular learning resource, and within a short period of time we had the majority of 2nd year lectures being recorded, uploaded & posted online. This project evolved into the eventual design of a “one-stop-shopping” website where current lecture media for the majority of the medical curriculum could be easily located & downloaded from a single page, and is currently managed by the Office of Medical Education.

Tegrity – Can It Impact Student Achievement & Retention?

I believe that having lecture media available 24/7 "should" have a positive impact on student learning. (A hypothesis currently being tested). In the Fall of 2007 I began a collaborative project with two Instructional Technologists in our School of Public Health (Bobbie Garner-Coffie & Vincente Bengoa) to conduct a pilot study using Tegrity Campus 2.0 for capturing & archiving Med Pharm lecture content in a key-word searchable video format. This media can be watched online, or downloaded to a computer (PC or Mac) or iPod for later viewing. Tegrity has report features that allow us to determine both the frequency and average duration that students view our hour-long lecture recordings. During a one-month time period our Med Pharm lectures were viewed 172 times for a total of ~91 hours, which averages to a viewing rate of ~30 minutes per time. My conclusion, similar to those reported by the company that developed Tegrity, is that the average student does not sit at home viewing lectures in their entirety. They view only those portions of lectures where they had incomplete notes, or did not fully understand a point being covered. The use of Tegrity for lecture recording expanded to other

courses in the medical curriculum during the 2008-09 academic year and is now funded by the Dean's office.

Introduction of Active Learning & Learner-Centered Teaching Strategies:

Traditional classroom lectures are “teacher-centered” and promote passive learning. As a first step in implementing active learning strategies in the classroom, I collaborated with our faculty to develop a one-credit mini course on "Concepts in Pharmacology" in the graduate curriculum. In addition, I worked with two of our faculty (Drs. Agrawal & Beckman) to convert 7 traditional Medical Pharmacology lectures to "Just-in-Time-Teaching" (JiTT) sessions using "Peer Instruction". In JiTT students complete a reading assignment & a post-reading quiz on Blackboard by midnight before a class session (Novak et al., 1999). One of the questions asked is a short answer essay on “*What did you find most difficult or confusing about the reading?*” These responses are used to determine the areas to be focused on during class. Students come to class prepared with background knowledge of the material. Use of interactive Classroom Response System questions on the identified areas of difficulty transforms a traditional lecture into a class session focused mainly on student needs. Most class sessions included at least one question using the “Peer Instruction” method (Crouch & Mazur, 2001; Crouch et al., 2007) where students are asked to select (on their own) the best answer to a challenging question. After responses are collected (but not displayed), students are asked to debate which answer is "best" or most correct with their neighbors for 3-4 minutes, and then vote again - after which a histogram is displayed. This active learning strategy significantly increased class performance on questions from 63.3% (1st vote) to 89.4% (2nd vote)($n=20$, $p<0.0001$). Further expansion of these techniques is planned for the 2009-10 academic year.

Introducing Human Patient Simulation into the T2 Curriculum (2009):

A METI Human Patient Simulation on the diagnosis & treatment of unstable angina & cardiac arrhythmias was developed for our 2nd year medical students. The outline for the simulation (case history & story line) was developed by Drs Krane, LeDoux and I. Based upon the case outline, I developed a METI HPS scenario to emulate the patient's presenting heart rate & blood pressure, and for simulating the symptoms of unstable angina with ST segment depression & associated changes in heart rate & blood pressure. The simulation included responses to drug administration (nitroglycerin, morphine, oxygen, metoprolol), simulation of various arrhythmias (bradycardia, AV block, VTach, VFib) and treatments (Cardioversion/Defibrillation, amiodarone, lidocaine & atropine). Dr. LeDoux played the role of the ER physician, and I coordinated the simulation & played the voice of the patient "Mr. Boudreaux" from a control room next door. We were able to get 180 medical students thru the simulation in small groups in a weeks time.

Director of Graduate Studies in Pharmacology (2005 to present)
Resurrection of Our Graduate Curriculum After Katrina:

In December 2005, while living in Houston & directing the Medical Pharmacology course, I assumed responsibility for our pharmacology department's doctoral and masters graduate programs. When classes resumed at the New Orleans downtown campus in mid-January of 2006, 25 (out of 40) masters students returned, along with 6 doctoral students. "Atypical" responsibilities during that semester included making trips back & forth between Houston & New Orleans to find rooms in our medical complex having acceptable air quality that we could use for teaching (most of the 1430 Tulane Ave building was still without complete power). We had an entire semester to "make up", so I had to restructure the graduate curriculum so that all previously scheduled graduate classes for the 2005-06 academic year could be completed during the Spring semester of 2006 & an extra Summer *lagniappe* semester in June-July of 2006. One component of this challenge was to find a way to simultaneously teach the complete Medical Pharmacology course at both the New Orleans campus (to our doctoral & masters students) & Baylor campus (to our medical students). Lectures on the two campuses had to be scheduled out of sync with each other, since our remaining teaching faculty could not be in two places at once. This was not a fun year for anyone.

Development of a New Thematic & Objective-Based Graduate Curriculum (2006-07):

During the summer of 2006, in response to student criticisms about our graduate curriculum, I initiated a series of major changes to the department's graduate curriculum. These changes were based upon a "proven" design – that of the 2nd year medical curriculum which had been redesigned over the previous decade:

- the traditional graduate curriculum was replaced with a thematic "organ-system" based design in which (as much as possible) all lectures in all graduate courses covered topics within the same theme being covered in Medical Pharmacology. This included topics covered in seminars & the weekly journal club. This change was designed to re-inforce student learning.
- With the help of our faculty, a list of specific learning objectives was developed for each graduate lecture given in our two primary graduate courses: Principles of Pharmacology & Pharmacology Research. Exams were designed to cover the material outlined in the learning objectives.
- Graduate exams were placed at the end of each Med Pharm "thematic block".
- Lecture handouts, containing learning objectives, were collated prior to each thematic block & distributed ahead-of-time to students. This allowed students to prepare for lectures ahead of time.
- Audio recordings of graduate lectures were initiated in the Fall of 2006 and a Graduate Resources website was developed that included the new thematic lecture schedule, and a media website was designed to provide links to down-loadable versions of all lecture audio recordings & lecture slides (html & pdf versions). During the 2008-09 academic year, a switch was made to use the Tegrity Classroom 2.0 recording system for graduate lectures.
  Graduate Resources Website url: http://tulane.edu/som/departments/pharmacology/gradresources/index.cfm

Systems Biology Course Directorship (2008-present):

The Systems Biology Course was a newly constructed course, first offered in Spring 2007 for the 1st year doctoral students in the School of Medicine's newly created umbrella "Biomedical Sciences" (BMS) doctoral program. Although this course looked great "on paper", it received some "negative" reviews in its end-of-course survey. The major criticisms of the course included: a) some lectures were excessive in length (90+ slides), b) there was excessive redundancy & duplication of material covered in different lectures, c) there was no communication between lecturers, d) no class notes were available before lecture, e) there were too many details to be remembered for exams, and f) there were not enough exams (e.g. 2 exams was not enough).

In the Summer of 2007, I was asked to take over as course director. After reviewing the survey results, a number of changes were made to address the concerns raised. These included:

- Development of a course website where all lecture slides are posted in html & pdf formats (url below). This allowed faculty & students easy access to the course content. This facilitated the discovery & elimination of excessive redundancy & lecture length, prior to when classes begun in Spring of 2008.
- Development of learning objectives for all lectures. These were posted on the course web site & are printed on the front cover of every lecture handout.
- Redesign of the course schedule to include a 3rd exam. Each of the progress exams covers 7, 7 & 9 lectures, respectively. Exam questions are based upon the stated lecture learning objectives, so as to level the playing field of what students "need to know".
- Creation of a course syllabus (collection of handouts & lecture schedule), collated, printed & distributed prior to each block of lectures.
- With the assistance of Jeanne Samuel in our Office of Medical Education, an online survey was developed so that students could provide anonymous feedback on individual lectures and exams.

For the 2009 academic year some additional adjustments to the course were made, including:

- streamlining the course content to focus in more depth on cardiovascular physiology & pharmacology
- converting all lectures to a 1 hr format (vs. "killer" 1.5 hr lectures), 3 lectures per week
- increased the number of exams to 5 total (more frequent & shorter exams).
- introduction of the Classroom Response System for 3 hrs of lecture. The use of the system was offered to other faculty.

In 2010 we added the use of a Course Management System (Blackboard) for:

- posting lecture media (pdf versions of powerpoint slides, handouts)
- email communication
- posting grades & exam histograms
- a mechanism for long-distance learning in the case of a major health epidemic affecting student ability to attend class

Concepts in Pharmacology Course Directorship (2008 pilot project):

To facilitate the development of active learning strategies in our graduate curriculum, I developed a 1 credit hour "pilot" course for the Masters in Pharmacology students. The course consisted of seven JiTT sessions that had a pre-class reading assignment, a pre-class Blackboard quiz, and a class session

focused on interactive CRS questions, including 3 questions at the end of each class session using the Peer Instruction method. The course grade was based upon performance on Blackboard quiz questions, and Peer Instruction questions. An end of course survey indicated a high level of student satisfaction, with a 4.6 out of 5 rating for “This course enhanced my learning” (1-5 scale). The lessons learned from this pilot project were utilized to implement & expand the number of active-learning JiTT sessions in our other graduate & medical courses (e.g. graduate course on Principles of Pharmacology & the 1st year Human Physiology courses).

Pharmwiki

In the summer of 2009 I initiated the development of a "pharmwiki" in collaboration with Tim Park (Class of 2011). This project is a learner-centered project that is creating an online interactive resource to explain concepts & key knowledge objectives in the field of Medical Pharmacology. During its initial year it has become the 2nd year medical class's 2nd most utilized information resource second only to lecture handouts. It has been constructed immediately before each systems block during the 2009-2010 academic year and contains:

- essential drug information (with hyperlinks to cited resources)
- summary tables
- figures & graphs illustrating mechanisms (when appropriate)
- interactive formative assessment quizzes (to illustrate how information & concepts can be applied in a clinical context - e.g. USMLE Step 1 style question format)
- background pathophysiology & sample clinical cases (mental scaffolding) to promote long-term retention & understanding of pharmacology. (Note: Due to time constraints - this component has only been partially developed & will undergo further expansion during the 2010-2011 academic year).

url: http://tmedweb.tulane.edu/pharmwiki/doku.php/

References:

1. Crouch CH and Mazur E: Peer instruction: ten years of experience and results. Am J Physics 69:970-977, 2001
2. Crouch CH, Watkins J, Fagen AP, Mazur E: Research-Based Reform of University Physics, 1 (1) 2007
3. Novak GM, Patterson ET, Gavrin AD, Christian W. Just-in-Time-Teaching: Blending Active Learning with Web Technology. Prentice Hall, Upper Saddle River, NJ. 1999. (ISBN 0-13-085034-9) (Online version of JiTT)

SECTION 6: CURRICULUM ASSESSMENT

Curricular Analysis: Large Block Exams Result in Fatigue & Decreased Performance

Prior to 1996, our 2nd year course in Medical Pharmacology was taught between February and May, 2-3 hrs of lecture per day, with laboratories typically occurring on Tuesday & Thursday afternoons. Our course did not overlap with any other core courses, and was taught as a traditional "silo" course. During the 1996-97 academic year, we began to "integrate" our 2nd yr medical curriculum into thematic system-based blocks where topics in several specialties (Med Pharm, Path, Pathophysiology, Microbiology, Immunology, Clinical Diagnosis) were coordinated. As a result, in 1996-97 we moved ~25% of our Medical Pharmacology curriculum to the Fall block (Inflammation, Cancer Chemotherapy & Antimicrobials). The remainder of the course took place in March thru May after students had completed the Pathology course. The same design was used during the 1997-98 academic year as well.

During the 1998-1999 academic year the extent of curricular coordination & integration was increased further, and during the Spring of 1999 we conducted our first experiment where the content covered in all courses (e.g. Pathophysiology, Pathology & Medical Pharmacology) was assessed during a single "mega" exam given on a Friday morning. Because of the amount of material covered on the exam, this exam was very long (~160 questions), requiring ~4 hours for many students to complete. The questions from the different sub-disciplines were randomly arranged throughout the exam.

Noticing the visual signs of fatigue on our student's faces during the latter half of the exam, I became alarmed and conducted a statistical analysis of exam performance following the exam.
The analysis revealed several significant trends.

- Student performance on the first 50 questions on the exam (Mean = 82.2% ± 8.8%) was significantly higher than on the last 50 questions (Mean = 73.3% ± 11.2%). The difference was highly significant (paired t test $P < 0.00000001$).
- The number of students with a failing grade on the last 50 questions (n=35) was 7-times higher than with the first 50 questions (n=5)
- To determine whether the top performing students also exhibited a similar significant "fatigue", I re-analyzed the data, looking only at those students having the top 20 scores on the exam (the brightest students). The results were qualitatively similar for the top performing students, as compared to the entire class. The average for the top 20 students dropped from 93.9% ± 2.3% on the first 50 questions to 85.8% ± 8.8% on the last 50 questions, a significant difference ($P<0.00025$). The number of top performing students having an "Honors" grade also dropped from 13 to 4 between the first 50 to the last 50 questions.

Following this analysis, as a partial solution to reduce fatigue, we began separating our exams by course, with 15-30 minute breaks in-between exams. However the Mechanisms of Disease (Pathology & Pathophysiology) and Pharmacology exams were still given on the same last Friday morning of a given coordinated block.

Nevertheless, the use of large Friday block exams continued to result in decreased student performance

(see attached figure), and an progressive increase in the number of students "failing" Medical Pharmacology with each block exam during the 1998-1999 academic year.

- The cumulative class average began to decline significantly, exam-by-exam for 3 exams after the block exam design was initiated during the 1998-99 academic year.
- The number of students in the class with a failing grade increased progressively with each exam from 1 to 4 after the 3 block exams.

My conclusion from these results is that "fatigue" is a real (reproducible & statistically significant) phenomena associated with the "block exam" model, even when mini-breaks are given between examination of different subjects.

Is it Valid to Use the NBME Exam As A Grade for the Final Exam?

One question that must be addressed before we can legitimately use scores obtained from the National Board of Medical Examiners (NBME) Shelf Exam as a valid assessment as a final exam is whether there is a good correlation between a student's grade at the end of the course (before the final exam), and their performance on the NBME final exam. If, for example, we were teaching a course on plant biology, I would expect that there would not be a good correlation between the course grade & performance on a standardized pharmacology exam, since the two topics are "apples vs. oranges". To assess this, I periodically compare the correlation of average student scores with their score on the NBME shelf exam. To date, there has always been a good correlation ($R \geq 0.70$, $P<0.0001$), as illustrated in the analyses conducted at the end of the 2004, 2005, 2006, 2008and 2009 academic years. I therefore conclude that the NBME score can be used as a valid assessment of a student's knowledge of pharmacology, and that a students knowledge of pharmacology at the end of our course correlates well with their performance (on average) on the NBME exam.

Spreading Out the Medical Pharmacology Course Results in Decreased NBME Performance:

At the end of the first two years of curriculum integration (1998-99 & 1999-2000) a trend of decreased student performance in Medical Pharmacology was also observed when analyzing student scores obtained on the NBME shelf exam:

- The class average on the end-of-course NBME shelf exam decreased significantly ($P<0.001$) after the 1998-1999 and 1999-2000 academic years when compared to the three previous years where there was minimal curricular integration & block exams were not used.

One might ask "why" there was a decrease in NBME test scores? It seems unlikely that longer "fatiguing" exams (a series of acute events) could decrease student performance on a standardized exam given at the end of the year. While there is more than one possible explanation, my best guess is that the decrease in NBME scores reflects the fact that the pharmacology course became significantly more "spread out" over the entire academic year (from August to May), resulting in lower student retention of the subjects covered at in the Fall semester. Prior to 1996-97, the pharmacology course began in February and ended in May (~ 3 hours per day), with no other significant competition in the curriculum. My hypothesis is that giving the entire course just prior to a standardized NBME exam most likely increases student performance, due to a more significant contribution of short-term retention. The fact that the end-of-course class average did not show a similar dip at the end of the 1999 & 200

academic year suggests that integration of the curriculum per se did not decrease exam performance (as one separate indicator of learning).

"Insanity: doing the same thing over and over again and expecting different results."
-Albert Einstein

Active Steps Taken To Enhance Student Review for the NBME & USMLE Exams:

After recognizing the "potential" negative impact of curricular change on exam performance in our Medical Pharmacology course I began an ongoing dialog (over several years) with our Owl Club representatives to try and determine what resources we could possibly provide that might increase student learning & help students to review & master our material. As a result of these discussions I made a series of changes to the Medical Pharmacology curriculum that included:

- Development & implementing learning objectives for each lecture (actually initiated during 1998-1999, prior to noticing the dip).
- Development of on-line interactive self-assessment exams first piloted during the 2000-2001 academic year (described in Section 5). Owl Club feedback was highly favorable.
- Developing "drug profiles" for each drug covered during the course. (Begun in 2003, completed in Jan 2005). These profiles are small tables containing a flash-card-like synopsis of each drug's mechanism of action, indications, contraindications, drug-interactions & side effects. The references used to create these Drug Profiles was the course text (Katzung) & an on-line version of the Physician's Desk Reference (www.rxlist.com). Once created, these drug profiles were distributed prior to each lecture block, and took over a year to develop.

After two years the downward trend in NBME scores reversed. As shown in the attached figure, our students performance on the shelf exam rebounded during the 2000-2001 academic year & remained between the 70th and 80th national percentile during the next 5 years until Katrina. While I would like to believe that the changes we made are directly responsible for the rebound, I know that education is an in-exact science. Part of the explanation could very well be that students (in response to feedback from classmates ahead of them) "adapted" their study habits, thus resulting in enhance performance on the NBME exam. Since we did not have a separate randomly selected "control group" that was un-exposed to our newly provided resources, we will probably never know the real answer. (I considered such a design impractical).

Assessing Active Learning & Learner-Centered Teaching Strategies:

During the 2008-09 academic year I initiated the development & implementation of active learning strategies in classroom instruction for both our graduate & medical curriculum. For the graduate curriculum I developed a one-credit pilot course on "Concepts in Pharmacology". In the medical curriculum I collaborated with two department colleagues to convert 7 traditional Medical Pharmacology lectures to "Just-in-Time-Teaching" sessions with "Peer Instruction". (These active learning strategies are described at the end of Section 5). The use of Peer Instruction significantly increased class performance on questions from 63.3% (1st vote) to 89.4% (2nd vote)($n=20$, $p<0.0001$). Further expansion of these techniques is planned for the 2009-10 academic year.

SECTION 7: EDUCATION-RELATED HONORS & AWARDS

- Owl Club Teaching Honor Roll* 1996-1997
- Owl Club Teaching Award - Outstanding 2nd Year Teaching Award 1997-1998
- Owl Club Second Year – Outstanding Professor, 2nd Semester 2000-2001
- Owl Club Second Year – Student Advocate 2001-2002
- Owl Club Second Year – Professor of the Year, Honorable Mention 2003-2004
- Owl Club Second Year – Professor of the Year Teaching Award 2005-2006
- Owl Club Second Year – Category 5 Teaching Award** 2005-2006
- Owl Club Second Year – Professor of the Year Teaching Award 2006-2007
- Owl Club Second Year – Professor of the Year Teaching Award 2007-2008
- Senior Vice President's Teaching Scholar Award (Tulane SOM) 2007-2008
- President's Award for Excellence in Teaching (Tulane Univ) 2007-2008
- Owl Club Second Year – Professor of the Year, Honorable Mention 2008-2009
- Owl Club Second Year – Clifford Newman Student Advocacy Award (for Members of the TmedWeb Team). 2008-2009
- Alpha Omega Alpha Medical Honor Society Teaching Award Tulane University School of Medicine 2009
- Owl Club Second Year – Professor of the Year Teaching Award 2010-2011
- Gloria P Walsh Award for Teaching Excellence (Owl Club) 2011
- Owl Club Second Year - Honorable Mention Best T2 Professor 2012
  I'm not sure, but I think this is like coming in 5th place in the Olympics
- Owl Club T2 "Humerus" Award 2013
- Owl Club T2 "Humerus" Award 2014
- Owl Club T2 Best PBL or TBL Facilitator Teaching award 2015
- Owl Club T2 Professor of the year Teaching award 2016

* Tulane Univ School of Medicine (Student Honor Society)

** "*For the five exceptional individuals keeping medical education afloat come hell and high water.*"

Awarded by the Owl Club the year after Hurricane Katrina. My favorite award. It was an emotional experience.