THE OLDER THE WINE THE BETTER IT GETS--

TEACHING AS A LIFELONG PROCESS OF GROWTH

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Let me skip the stories and poetry and the temptation to deal in nice but vague rhetoric and instead speak of gratitudes, achievements, and accolades for teaching excellence. First and foremost, it is both an honor and a pleasure for me to be here and to be a small part of a great University of New Hampshire (UNH) tradition. On behalf of the previous winners of the Jean Brierley Award, and for all of those dedicated teachers at UNH, I would like to thank the Brierley Committee for this award.

I would like to thank, also, those individuals who have made this day possible, beginning with my parents and my brother, who gave me love and support throughout my life for which I will always be grateful. They also taught me the importance of getting an education and instilled in me a dedication to academic excellence. I would also like to thank my colleagues in the Kinesiology Department who have made being a faculty member at UNH fun, and Ray Coward, former Dean of the School of Health and Human Services, for nominating me for this prestigious award.

Historically, faculty have been rewarded not so much for their excellence in the classroom, but rather for their contributions to their respective fields. At the University of New Hampshire this is not the case. Here, teaching excellence is part of the institutional culture and is a commodity that is valued and rewarded appropriately. The previous winners of the Jean Brierley Award are testaments to this fact. The University of New Hampshire is a major research institution which also has a strong commitment to undergraduate and graduate education. At UNH teaching and research missions are well integrated. Research is seen not only as a vehicle to expand the body of knowledge within a particular discipline, but as a vehicle to strengthen the university's educational mission. The Brierley Award is a means by which UNH encourages and supports faculty in their teaching mission.

In organizing this lecture I considered many things regarding teaching and its significance in higher education, but two themes stood out. Most important were those books and articles which profoundly influenced my thoughts on the art of teaching in higher education. Two books in particular come to mind: The Closing of the American Mind by Harold Bloom1 and Frames of Mind: The Theory of Multiple Intelligences by Howard Gardner.8 The former reintroduced me to the importance of a classical liberal arts education in the undergraduate curricula; the latter made me aware of different learning styles and the importance of adapting my teaching style to facilitate student learning. Both of these books have, in some way, contributed to my success in the classroom. I strongly urge all who are interested in teaching to read these books.

The second theme focuses on the marvellous subject matter I teach, and the mentors, students, and theorists who have not only influenced my philosophy of teaching, but who have also influenced how I teach. It is around this theme that this lecture will evolve.

TEACHING AND LEARNING IN HIGHER EDUCATION

As previously mentioned, most faculty at America's universities have been rewarded not so much for their excellence in the classroom, as for their scholarly contributions to their respective fields. Research has been, and remains to this day, the primary avenue to both institutional and individual prestige. Because higher education's reward system for faculty is dominated by the ethos of research and not for distinction in the classroom, faculty often have little or no incentive to develop their teaching skills and see little or no reason to do things differently than is expected by their institutional culture. College and university administrators talk a good game about excellence in teaching, but this is often just lip service. And although the repertoire of teaching practices is far greater than ever before on college campuses--including the use of cooperative learning, problem-based learning, case-method teaching, and technology-based teaching to expand student involvement in the learning process--and teaching centers (institutes) abound, in most cases reform in college and university teaching has been shallow and relatively superficial.10

Unfortunately most faculty function in a routine that suggests that they are not really concerned with the processes by which students learn, reason, and think. They are merely imparting information, and one who merely imparts information when the knowledge of the world is inextricably intertwined is surely not an educator. I suspect that many of my colleagues, both here and at other institutions, were drawn to academia because they wanted to do research. For them, teaching was only an unfortunate obligation. Faced with this mindset our students can only suffer.

A very important phenomenon, however, is changing the presumption in academia that research is the primary, and very often the only, mission of a university. In 1997, the Carnegie Foundation called for a new model of undergraduate education at research institutions, one which incorporated the baccalaureate experience as part of an integrated whole.10 Now, more than ever before, there is a much greater emphasis on the connection between teaching and learning in the classroom and how faculty can facilitate the acquisition of knowledge in their students. This change, I believe, benefits both students and faculty alike.

Just how important is teaching in today's higher education? For me, educating our undergraduate and graduate students is as important as research. Our mission here at UNH is the acquisition of new knowledge through research, and the transmission of this knowledge to our students through teaching. A teacher is crucial for a student's progress on the path of knowledge. Effective teachers, it has been said,4 give us a sense of who we are and who we might become. Teachers unlock the minds and imaginations of their students by posing compelling questions; they teach their students to reason and think, urging them to aspire to new goals, reaching higher and further than they have before.

And like talented and gifted leaders in many fields, gifted teachers often become liberating forces in the lives of those individuals they have taught.

As I look back on my own life, nearly all the people who I respected most in life have been teachers. I can see how indispensable my teachers have been to me and how much I have learned from the good ones, as well as how much I have learned about what not to do from the not so good ones. The limitations and difficulties I have faced in life in general, and academia in particular, would have been more demanding without their help and guidance.

On the most utilitarian level, a teacher offers instruction in both the theory and practice of a particular discipline. For example,12 anyone can learn to cook by reading cook books and following recipes. All the pertinent information will be there and all one needs to do is follow directions and learn by trial and error. But there is something special about cooking that reading a cook book can never totally impart to you--little devices and practices that can best be summed up with the word "panache." You can learn things from a master chef that cannot really be taught by books and that would take a great deal of time and trial and error to learn on your own. You learn something from personal instruction that all the books, however clear and informative, cannot pass on. This is the essence of a teacher.

It is important, however, for both faculty and administrators to recognize that being an excellent teacher and being an active scholar do not have to be mutually exclusive. Excellent teachers can be active scholars, and high-quality research and high-quality teaching can be mutually supportive. One need not look farther than one of the most influential scientists and educators in the history of humankind, and an individual who is a personal hero of mine. Galileo Galilei, the great Italian philosopher, scientist, and astronomer of the early 17th century, whose contributions to the content, the methodology, and the instrumentation of science were so many, so critical, and so important that the title "Father of Modern Science" is often reserved for him.5 In addition to being a great scientist, Galileo was also known to be an illustrious educator, first at the University of Pisa and then at the University of Padua.

Reflecting back on my experiences in Italy, I particularly recall reading about Galileo's tenure at the University of Padua. On December 7, 1592, an eager Galileo delivered his inaugural lecture to a large audience of his peers in the Aula Magna or Great Hall, a room that still exists to this day, and a room I frequented quite often during my stay in Italy. By ancient Paduan tradition, the new professor was required to present himself before the university community and the celebrated families of Venice to deliver an oration in Latin upon the fundamental principles of his field. Here was this brilliant man, dressed in formal garb, lecturing to the brightest and best that renaissance Italy and Europe had to offer. By all reports, his oration was electrifying!5 At the University of Pisa Galileo had already developed a seasoned and captivating lecturing style. But it was here at Padua that his oratory became celebrated.

For many years I imagined what it would be like to lecture in such a room, in front of eager students and colleagues and, believe it or not, to this day this vision has influenced me as an educator. For although some of my students may not always be the most eager to learn, and many often care more about what they need to know for a particular test than they do about learning the material per se, this idealistic vision of Galileo lecturing to an eager and captivated audience has stayed with me since my first day in academia.

As you know, Galileo was more than an educator, he was first and foremost the pre-eminent scholar of his time. It was during his teaching tenure at Pisa and Padua and the decades that would follow that Galileo would formulate some of the most profound works in all of the history of science: the concept of instantaneous velocity and the behavior of bodies in free fall; a conservation-of-motion principle, synthesizing Archimedean statics and Aristotelian dynamics; and a theory of tides. The laws of inertial motion and falling bodies started with Galileo, evolved under Sir Isaac Newton, were perfected by Albert Einstein, and later were tested in outer space by Astronaut Neil Armstrong when he dropped a hammer and a feather and watched them reach the surface at the same time. "You see, Galileo was right!" Armstrong remarked gleefully.5

As is illustrated by Galileo's example, being an excellent teacher and being a first-rate scholar are not mutually exclusive entities. Indeed, active researchers and scholars may even make better teachers.4 On the other hand, it is also true that research steals away time from many teaching obligations: course preparation, grading, student meetings, review sessions, and the like. The balance between research and teaching is a precarious one, and few faculty can balance both well enough to excel at both. I tip my hat to those faculty who have found this balance.

WHAT DEFINES GOOD TEACHING

With this renewed interest in educating our students, one might ask the ultimate question of what makes a good teacher? The Indian Buddhist Sage Nagarjuna described the ideal teacher as one who possesses much learning and great wisdom, and one who gives great practical advice. Others suggest that there are certain qualities which make a good teacher.4,6 According to Kenneth Eble,6 the seven deadly sins of a college teacher are arrogance, dullness, rigidity, insensitivity, vanity, self-indulgence, and hypocrisy. Excellent teachers, on the other hand, cultivate the opposite qualities in themselves: humility, enthusiasm, flexibility, sensitivity, compassion, discipline, and commitment. To paraphrase Thomas Cronin,4 successful teachers are passionate about what they do. They love to teach as a painter loves to paint, as a writer loves to write, as a composer loves to compose, as a singer loves to sing, and they can get excited about their subject no matter how many times before they have lectured on it.

I could not bear losing the delight of giving a great lecture where students and I are synchronic, where there is this perfect ebb and flow of information between them and me. I think many of you here today know what I mean. It is as if there exists teaching

nirvana! As you can tell, I am very passionate and idealistic about my vocation. I have always had this gut feeling about the capacity of teachers to profoundly change and solve, or at least minimize, many of the problems faced by our society. I have always wanted to be part of a process that in some way, could have a profound affect on the lives of people.

Many years ago, I remember having a conversation about teaching with my good friend and colleague, Neil Vroman. I believe it was he who said that teaching, like so many things we do, is a performing art. Little things we do--varying the tempo of delivery, eye contact, posture, body language, voice inflections, facial expression, and enthusiasm--have as much to do with good teaching as the subject matter taught. In many ways, good teachers are similar to good actors, honing their craft to the point of perfection. Learning to be an excellent teacher is a career-long undertaking; good teachers are continuously learning their trade and are always in the process of evolving. At times I still think I am as nascent a teacher as the day I started, with many things still to learn.

I can remember vividly my own personal journey as a teacher in higher education. During my doctoral training, I learned a great deal about how not to teach from many ghastly professors. But on the other hand, several professors had a profound influence on how I approached the art and science of teaching. Both the good and the bad have influenced how I teach. In essence, my teaching style is an amalgam of the teaching styles of those professors, plus a few pointers I picked up over many years of teaching and through many discussions with colleagues. Let me share some of these with you at this time.

The most influential of these professors was my doctoral mentor, Dr. Frank Papscy. He was an educator who was incomparable in using the Socratic method: always a question, continually probing for the most complete answer. From him I learned how to incorporate questioning into my lectures and how to get students to think.

Another teaching mentor was one of my professors in neuropsychology, who knew his material so well that his lectures appeared to be extemporaneous. His lectures were the most polished and flowing of any I have ever witnessed. Not only did he avoid lecturing verbatim from a script, he never, ever, looked at his notes! From him, I learned "Know thy material," don't be tied to your notes, maintain eye contact with students, and move around the lecture hall to personalize the lecture and engage students.

There were also several anatomy professors from Medical School in Italy who had a profound influence on how I teach. Their lectures on functional anatomy and pathology were always peppered with real-life and clinical anecdotes. Because of this direct relationship between structure and function of the human body to pathology, their lectures were always invigorating and engaging. From them I learned that lecture material, at some point, must be applied to real-life scenarios.

In addition to their lectures having clinical relevancy, their lectures almost always captured our interest and attention from the beginning, with either a provocative story or with an array of awe- inspiring facts. These two techniques--that of captivating and

"grabbing" the students' attention at the very beginning of the lecture and that of "bringing home" the information with a vivid illustration or some problem solving scenario--are critical to successful teaching at any level. In the flow of a particular lecture I endeavor to provide at least one clear, forthright example to drive the information from the day's lecture home. I use these narratives to illustrate to students how they might apply information learned in class to hypothetical clinical and professional situations. Let me explain by example.

One of the classes I teach is the neural basis of motor control. In one of the lectures in this class I discuss how consequential environmental influences are on the development of functional neural synapses, and how important it is to teach skills during the so-called critical periods of development. This is seen most readily in speech and language acquisition, but also in the development of physical and motor skills. To grab my students' attention in this lecture, I often begin class with a cornucopia of facts on the complexity of the human brain. It usually goes something like this.

The human brain is the product of nearly 400 million years of Darwinian evolution. As the neurophilosopher Paul Churchland so eloquently stated, the human brain is "the engine of reason and the seat of the soul."2 This mass of gray and white tissue, about the size of a grapefruit and weighing approximately 3 pounds, mediates learning and memory and regulates a host of bodily functions; it enables our muscles to accomplish incredible feats of physical dexterity while simultaneously enabling us to sense the environment and give meaning to this information--the flickering shadow of a burning candle, the fluttering wings of a hummingbird in flight, the fleet-footed attack of a cheetah--in an instant. Our visual cortex alone is capable of processing nearly 130 million bits of information per second and our brains have to know, understand, and react to this information in fractions of a second.3,13

At the most basic level, our brains are comprised of over 100 billion nerve cells, or neurons--each a few millionths of a meter wide--which make over 100 trillion connections, called synapses. If one would take a piece of brain just the size of a grain of sand, it would contain one hundred thousand neurons, two million axons, and one billion synapses, all "chattering" to one another.11 As a point of fact, if we consider the number of possible neural circuits, we would be dealing with infinite numbers: 10 followed by at least one-million zeros. Consider this with respect to the number of particles in the known universe, 10 followed by 79 zeros, or the volume in cubic meters of the entire astronomical universe, 10 raised to the 87th power.7,11 For humans, the number of neurons and cellular connections which comprise the brain truly is prodigious. I believe that Edward Wilson, Professor of Biology at Harvard University, said it best when he stated, "the human brain is the most complex object in the universe--known, that is, to itself."14

But as incredible as these facts may be, it may be even more astonishing that the global configuration of the 100 trillion connections found in the human brain is distinctive for each individual and in some way determines how an individual's brain reacts to sensory

information, how it plots its present and future behaviors, and how it moves within its environment. Yet considering the complexity of human behavior, a mere 1%-2% of the gene pool, less than one thousand genes based on our current knowledge of the human genome, manages to control all of these synapses, all of these behaviors, and all of these interactions. As I ask my students, "How can these relatively few genes do so much more for us than they do for any other species on this planet?"

As I explain to my students, in order to understand why this is so, you need to understand that our brains have developed the ability to alter their environment far beyond the capabilities of any other species. By changing and controlling our environment, our brains have evolved to such an extent that they have the ability to direct their own development. Whereas the brains of many species are fully developed at birth, our brains are just beginning and continue to grow expeditiously. At least 75% of our brain develops after birth where environmental influences can help forge its structure and function to levels unprecedented, heretofore, in nature.9 And it is during this prolonged period of brain growth and development, that our brains are most predisposed to environmental influences. Therefore, it is not just our genes that determine how the trillions of synapses are to interact, but environmental factors as well. To use a computer analogy it is as if the environment helps in writing the software of who and what we are.9

A case in point to illustrate this feature of our brains, one which students seem to appreciate, is the odyssey of Michael Jordan to become a professional baseball player. Michael Jordan was arguably the greatest athlete the world has ever seen. ESPN immortalized Mr. Jordan when it named him the greatest athlete of the 20th century. His athletic abilities were beyond belief. When you saw Michael Jordan perform on the basketball court, you fully understood that you were looking at the most perfect selection of muscle symmetry, of complete grace and power, of complete mental and physical coordination, that anyone has ever seen, or likely will ever see, for some time. Nonetheless, at the ripe old age of 30, Michael Jordan stunned the sports world by retiring from the game that brought him fame, fortune, and the admiration of countless millions of fans.

Within a few months of his untimely retirement from basketball, Jordan signed a minor league baseball contract with the Chicago White Sox. Given Jordan's extraordinary athletic gifts, many felt that it would be only a matter of time before he would guide the White Sox triumphantly into baseball's promise land--the World Series. Many of the local sport pundits were blithely predicting that it was just a matter of time before his sheer athletic prowess would bring him fame, fortune, and accolades in another sport. A little voice inside me, however, told me otherwise.

Michael Jordan had primarily played basketball throughout his life and, because of this fact, I, as well as others in neuroscience,9 knew that his ability to hit a baseball would be dubious. His inability to hit a baseball would be based not on his lack of dedication to the sport, for Michael Jordan was the consummate competitor who trained arduously during his years as a college and professional basketball player, nor on his lack of athletic ability, but rather on his brain. To hit a baseball is a very complex visuomotor skill and,

similar to all such motor skills, by necessity must be learned, and learned well. Michael Jordan's brain was no different from my brain, or your brain, or any other human brain for that matter. His incomparable skills on the basketball court were the culmination of countless hours of practice at a time when his brain was still developing and capable of nurturing a unique set of neuronal connections.

Notwithstanding his basketball skills, when it came to hitting a baseball Michael Jordan was like any other young adult, non-baseball player. His brain never learned how to recognize the nuances of a ball in flight or how to automatically and instantaneously coordinate his swing through the interplay of hundreds of muscles so that at that precise moment in time he could locate the ball and hit it soundly. Even at the age of 30, in the peak of physical condition, Michael's brain was just too old to do the job and, as a result, he was a complete and utter failure at baseball. The statistics show that in 13 exhibition games with the White Sox he managed only three puny singles. In one season with the Double A Birmingham Barons, Michael hit a paltry .202 and managed only three home runs while striking out 28% of the time. His strikeout to home run ratio was a dismal 30. In comparison, Babe Ruth's was under 2.9

As my students now know, this story illustrates a very critical point in human brain development. Early brain-environment interactions build upon the plasticity of the still-developing brain. There are critical periods, or what psychologists refer to as "windows of opportunity," and we find these windows for all types of learning. The critical learning period for hitting is not that much different from that for language, or for reading, or for writing, or for playing the piano. If a skill is not acquired during this critical period, then the acquisition of that skill later in life will be more difficult, if not impossible. I firmly believe that using anecdotes, such as the odyssey of Michael Jordan to become a professional baseball player, will help students bridge the gap from simply being passive learners of information to seeing the professional relevance of that information.

CONCLUDING REMARKS

Although I firmly believe that many of us are destined to be good teachers, one can become an engaging instructor only if one truly wants to. What I have learned in the past 18 years of university teaching is that, first and foremost, students prefer instructors who are clear, interesting, and well prepared, and view these qualities as essential to their success in the classroom. They also prefer instructors who stimulate interest in the subject matter and who, for a lack of a better term, are "providing" instructors. "Providing" instructors promote students' collaborations in learning and encourage them to seek help when needed. They provide the student with a supportive learning environment and demonstrate the processes by which we all learn. It seems to me that the important thing is not so much the teaching technique used nor the wealth of information that is taught, but rather the passion, the wit, and the vigor with which the teacher teaches that is of the utmost importance.

Thank you for listening. You have been a gracious audience. Let me conclude with a quote from the pre-eminent physicist of our time, Albert Einstein, who once said: "We

should make things as simple as possible, but not simpler." To this I would add, that the art of teaching entails making the difficult, as well as the simple, understandable by devising the means of making it so.

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