T.Q.M. IN THE CLASSROOM

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Abstract

The author re-examines university teaching strategies to support teaching innovations and classroom excellence. He has applied some of the principles of Total Quality Management to classroom teaching with a view to facilitate better classroom management and increased student participation. The author reports on his findings while applying a set of twenty principles to teach a senior level engineering course. These twenty principles were developed using the landmark work established by W. Edwards Deming. Deming is perhaps best known for his work in Japan, which started the *quality movement* during the 1950's. After observing the success of the Japanese, American manufacturing industries and organizations, realized the profound importance of Dr. Deming's teachings. Subsequently, this led to a sweeping *quality revolution* throughout the United States.

President Reagan awarded the National Medal of Technology to Dr. Deming in 1987. He was inducted into the Automotive Hall of Fame in 1991. During the seventies and eighties, quality became the *buzzword* of industry, organizations and institutions. Several awards have been instituted to promote quality. It is very well known that *The Malcolm Baldrige National Quality Award* is one of three global quality awards coveted by companies all over the world. The main focus here, is to document success in seven selected areas : leadership, strategic planning, customer's market focus, information analysis, human resources, process management and business results.

Following the footsteps of Dr. Deming's teachings, the author re-visits the learning pyramid and examines Deming's *'14 Points for Management'* and their usefulness while discussing an engineering subject matter. The author uses those principles of TQM to investigating ways to promote good teaching and raises a number of issues about supporting innovative and creative teaching methods in an institution of higher learning. Based on his classroom experiences, he concludes that a culture of creative changes and significant teaching improvements can be accomplished by applying some of the principles of TQM to the classroom experience across a university.

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Introduction

Ernest L. Boyer, in his 1990 book, "Scholarship Reconsidered: Priorities of the Professorate" suggests that there has been an attempt to redefine the university teacher-scholar's role in the academic environment. In his 1990 book, published by the *Carnegie Foundation for the Advancement of Teaching,* Boyer cites some ground breaking studies and offers a new paradigm that identifies the need to recognize the growing conversation about teaching, scholarship and research in the universities. Boyer's research on redefining scholarly work to include teaching has had a profound impact on the way teaching is viewed at universities and colleges.

Regardless, the relationship between scholarship of teaching and scholarship of discovery research is neither simple nor can easily be documented. Several studies have indicated that outstanding research faculty need not necessarily be good classroom teachers. Further, teachers who excel in the classroom need not necessarily be good at research. However, it is clear that it is possible to improve teaching, through better effort. Everyone agrees that both activities are important in universities. Traditionally, outstanding research has always been rewarded better than outstanding teaching, because of the perception that research is a high-stakes activity in the academic environment.

Universities, colleges and educational institutions do not adapt to change easily. Their traditional infrastructures call for ideas that are much more likely to foster stability rather than change. In spite of this, one should recognize that things are changing for the better, in many cases. Now-a-days universities are showing greater interest in the teaching activities of its faculty members, and *'Lilly Conference on College Teaching'* is a classic example. Opportunities are being provided for teachers to learn more about the 'scholarship of teaching'. Foundations, endowments and grants have been supporting initiatives aimed at improving classroom teaching.

The 'ACORN' Model

The use of 'ACORN' model suggested by Hawkins and Winter to conquer and mastering change, may offer some helpful hints for the novice professor.

Action : It is possible to effectively change things *only* when a teaching professor actually tries out a new idea.

Communication : Changes are successful *only* when the new ideas effectively communicated and implemented.

Ownership : Support for change is extremely important and is critical. *Only* strong commitment for accepting changes demonstrates genuine leadership.

Reflection : Feedback helps towards thoughtful evaluation of the changes implemented. *Only* reflection can provide a tool for continuous improvement.

Nurture : Implemented changes deliver results *only* when nurtured and promoted with necessary support systems, documentation and infrastructures.

The T.Q.M. Principles

Inspired by the ACORN model, the author experimented on implementing certain principles of 'Total Quality Management' in the classroom. The author believes that the following twenty principles (derived from Deming's ideas) help the teaching professor in a variety of ways to excel in his or her field.

1. Break down all barriers.
2. Create consistency of purpose with a plan.
3. Adopt the new philosophy of quality.
4. Establish high standards.
5. Establish targets / goals.
6. Reduce dependence on lectures.
7. Employ modern methods.
8. Control the process.
9. Organize to reach goals.
10. Prevention vs. correction.
11. Periodic improvements.
12. Maintain momentum.
13. Feedback : Communication.
14. Fact – based decisions.
15. Exploit opportunities.
16. Mobilization of expertise.
17. Drive out fear.
18. Recognition / keep score.
19. Identify accomplishments.
20. Customer focus / results.

As mentioned earlier, Total Quality Management or T.Q.M. is an idea that was developed by W. Edwards Deming and is based on existing philosophies and techniques. The movement was a reaction of United States companies in response to declining productivity and sales in the worldwide trade market due to inferior quality. Total quality management is a series of procedures and philosophies taken to create an environment, or culture, of success. It is essentially a concept or philosophy for managing operations. It is a set of action-oriented principles and practical ideas for effective classroom management. It is a framework for improving the way in which the teachers and learners interact. It is a new culture, a mind-set. It is a prescription for organizational effectiveness.

This paper explores the possibilities of incorporating these principles *judiciously* in to the classroom, to teach a diversified student body with different learning styles. The ultimate objective is to achieve excellence in lectures, tutorials as well as laboratory sessions.

Although the idea of total quality management is relatively new, the basic principles have been used for centuries. However, the total quality management movement can be attributed to a few selected intellectuals who put forward a systematic and methodical approach for improving quality. W. Edwards Deming, Joseph M. Juran, and Philip Crosby are considered to be the pioneers of TQM. Each man has his own criteria for quality management, however, one can easily correlate several characteristics and identify many similarities between the principles and ideas. In this paper, the author has re-organized and re-arranged these "Points of Quality" and adapted it in such a manner that it would suit the classroom environment better. Some of these points are discussed below in greater detail.

Breaking down the barriers is a key element in paving the path for education in the new millennium. Integrating the system of education helps the students to grasp a better understanding of the variety of topics covered in the subject matter. It is essential to bring everything *together* so that the learner can appreciate the *big picture.* It might be easy in some cases, however, in certain other areas, the instructor may have to resort to very creative methods in order to accomplish this goal. It is important to observe that this can be easily accomplished while teaching engineering subjects. Beginner's level engineering courses are always built on solid foundation of physics, chemistry and mathematics. Students feel very comfortable when they realize that the techniques they learnt in mathematics are actually being utilized to solve engineering design problems. It is imperative that advanced level engineering courses essentially utilize the knowledge gained during the *'entry level'* engineering courses.

Creating consistency of purpose with a plan is again, an extremely useful strategy while teaching a diversified student body. Student body could be of different race, different ethnic backgrounds, different religious affiliations, different nationalities, different gender, different age groups, different learning styles, etc. Regardless, a set of structured syllabus, well planned learning program with an effectively executed lesson-plan, is guaranteed to accomplish the desired objectives with a purpose. Even simple things such as using engineering paper while solving in-class examples or homework assignments, may enable the students to understand the material with better clarity.

Quality is defined as *conformance to requirements*, not "goodness." The instructor can be instrumental in enforcing this philosophy of quality in all respects. Quality work should be expected in students' written laboratory reports, examinations, tests, quizzes, take-home assignments, homeworks, creative drawings, technical topic presentations, research reports, etc. This can be effectively accomplished by providing the students with a *model* report. The *model* or the *format* can be instructor-generated or one that is standard and already available in the system. Even a very diversified student body will be able follow a standardized model, whether it be for a publication or be it for an assignment.
Establishing high standards obviously should receive priority billing. American industry now wants the performance standard to be set for "zero defects", and *not* "that's close enough." Teachers should adopt the same philosophy in the classroom as well. Once the instructor sets the standards high, students recognize the need for established standards and will set their goals high. They will strive hard towards achieving the set goals. Here, we can re-iterate the well-known phrase *"Reach for the sky, you will touch the ceiling"*.

American industry again, insists on establishing goals that are realistic and attainable within the targeted time frame. One should adopt this principle in one's syllabus. A well-structured syllabus should cover the required material in a 10-week quarter or a 15-week semester. "We were unable to cover that particular chapter" is inexcusable. It only indicates that the syllabus was improperly structured. One should provide enough "wiggle-room" while one writes the syllabus. "Problems & Discussion" sessions provide enough leeway for the instructor to accommodate unforeseen circumstances such as snow days, absence for conferences, etc.

It is believed that student's average retention level of a lectured/listened-to material is relatively very poor. Instructors need to be creative and quality time management can result in a very dynamic and productive lecture session.

Lectured material must be reinforced using descriptive handout material, thought provoking homework exercises, creative laboratory assignments, exhaustive research-reports, interesting project demonstrations, animated audio-visual aids, productive web-search data and the like. Students must be required and encouraged to participate in a variety of different activities that promote learning. The author utilized most of the above-mentioned techniques to deviate from a *traditional* lecture format.

First, the students were *required* to read the assigned topic (for example, '*Filter Design'*) before participating in a lecture class. This results in a population of learners that are indeed well prepared to discuss the subject matter in question. At the lecture meeting, a one-page handout was distributed wherein the ideas and formulae pertaining to filter design were reinforced. The instructor then solved a sample problem and this was immediately followed by an in-class exercise. This included a graphical plot of filter characteristics, such as a 'Bode Plot.' Later, the students were asked to *surf* the Internet to find out a website that provided exhaustive details regarding different filter designs. For the homework the students were required to solve additional problem sets, utilize software such as MATLAB, write research reports about the various scientists, compare the merits and disadvantages of different designs, indicate real world applications, etc. The above methodology was continued in the laboratory session that followed the lecture class. The students were able to actually construct, test and verify their theoretical designs. Detailed laboratory reports were required to be submitted at the next laboratory session.

Integrate the system of education with the latest in the technology. Students should be able to access information in multiple ways. One of the methods is to create a web site wherein lecture material is made available, in written form, to those who are in need of it. A well-organized, interactive slide show that stresses the important aspects of the subject matter is always very well received by the learner. Creative use of power point custom animation techniques may help the instructors in multiple ways. For example, wonderful *'Java Applets on Physics'* by Walter Fendt are available at the *sciencejoywagon* website.

A highly structured syllabus clearly specifies the goals attained by the student taking the course. In particular, it should outline the various milestones that are crossed during specified intervals. Both the instructor and the learner find this type of organization essential for smooth transition to a higher-level course curriculum. At time, the instructor may find that the sequence of subject matter as suggested by the textbook may not necessarily be appropriate for a selected group of audience. The instructor may have to re-organize the content by either adding or deleting certain selected topics to adjust the level of academic rigor.

Industry feels that : *"The system for developing quality is the prevention of poor-quality through process control and not by appraisal or correction."* This is true in the classroom as well ! Obtaining continuous feedback from the students help the instructor to *'change gears'* whenever appropriate.Permitting a student to take an entry-level engineering course without the necessary pre-requisites such as physics & mathematics is a classic example. Systematic addition to the *'knowledge-base'* of the learner is always beneficial to the student as well as the instructor. One can say that the order is highly streamlined while teaching engineering subject matter. For example, Mathematics – Physics – Statics – Strength of Materials – Dynamics – Thermodynamics may form a sequence of appropriate engineering science subject matter. Instructors should strive to achieve such streamlining in other areas as well.

It is said that some students *may* have *fear* of facing examinations. They know the subject matter but are unable to present it in an appropriate manner in a time-driven examination-hall environment. While elimination of examinations is inappropriate, it is very important and extremely essential that instructors resort to using multiple ways of assessing student learning. Students' progress must be monitored throughout the course term. Carefully analyzing a well-organized student course portfolio would be one of the suggested methods. Graded student portfolio must contain a variety of items. These include but not limited to : well-recorded class notes, completed homework assignments, exhaustive laboratory reports, well researched material, creative term papers, productive tech topic discussions, appropriate in-class quizzes, completed tests, submitted take-home examinations, comprehensive final examination, etc.

Conclusion

The reason that an improvement in quality was and is still needed in the classroom is due to the fact that universities are facing challenging problems not only on the technological front but also on the socio-economic front. On the technological front, *web-based education* and *distance learning methods* have opened up new horizons for the *non-traditional student.* These have imposed budget strain not only on capital investment, but also on faculty development skills. On the socio-economic front, again, the *non-traditional student* who has to balance work and college has asked the universities to provide creative scheduling in course offerings. Evening classes have been attracting increasing number of students now a days. This eases economic constraints. There may not be a need to add additional faculty, because many evening classes are managed by adjunct faculty. The universities are actively responding to the changes that are taking place in the global consumer marketplace.

Obviously, there are numerous benefits of *Total Quality Management,* however, they can be summarized into the following six categories. First, and perhaps the most important : The university achieves *'learner'* satisfaction that results in *learner* loyalty that in turn will attract more qualified *learners.*

Second, quality lowers the cost per pupil, consequently resulting in increased productivity backed by a stronger economic structure and forecast.

Third, quality improves the cash flow and cash reserves of the university. It is possible to find high quality instructors in local industry who might be willing to share their experiences during evening classes that meet once a week. The full-time faculty however, may organize, design and develop the course in consultation with the industrial experts. This type of industry-academia collaborative efforts is beneficial in many ways.

Compensation for adjunct faculty, whose responsibility may be to teach a single course per semester is much less than a full time faculty in a university. By providing this type of *expert* instructors, the full time faculty member is provided *release* time. The faculty member has more time to concentrate on securing research grants that would eventually help the financial position of the university. It should be recognized that this has been accomplished without any sacrifice in quality. The students continue to get high quality instruction from an expert who works in a relevant industry. The subject matter and the material is being constantly updated and revised under the supervision of an experienced faculty member.

Fourth, having high quality enables the university to justify the need for high costs of tuition and fees. Higher quality instruction requires smaller class sizes that permit closer interaction between the instructor and the learner. Further multiple sections may have to be scheduled during different time periods over days as well as evenings, not to mention Saturdays. All these warrant additional faculty, staff, technical personnel and support staff. Learners may be willing to accommodate increased costs if they feel that class scheduling meet their needs and necessities.

Fifth, better quality results in attracting *top-quality learners* leading to happier and *satisfied learners,* not to mention greater prosperity for the university as a whole.

Sixth, quality results in reduced complaints, thus meaning fewer hours spent on answering or correcting the situation. The university faculty and staff are thus able to devote more time on productive scholarly activities, meaningful research and community service.

The author has utilized several of the above-mentioned methods to improve his teaching methodologies. Further, he continues to apply the principles of TQM to the courses that he teaches. Feedback from the students has indicated that deviation from a traditional lecture-homework-examination format has proved to be a beneficial learning exercise for the students. Documentation in the form of a student course curriculum portfolio has been very productive and useful.

Bibliographic Information

1. Arnold, M. (1999). *Mainstreaming the digital revolution*. Higher Education Quarterly, 53, 49-64.

2. Beidler, P. G. & Tong, R. . (1994). *Learning to Teach.* Journal on Excellence in College Teaching, 5(1), 107-26.

3. Boyer, Ernest L. (1990). *Scholarship reconsidered: Priorities of the Professorate.* Princeton, NJ: Carnegie Foundation for the Advancement of Teaching.

4. Buzzel, Robert D., and Bradley T. Gale. (1987). *Profit Impact on Market Strategy: The PIMS Principle.* New York: Free Press.

5. Deming, W. Edwards. (1986) *Out of the Crisis.* Cambridge, MA : The MIT Press.

6. Deming, W. Edwards. (1994) *The New Economics.* Cambridge, MA : The MIT Press.

7. George, Pamela G. (1994). *The Effectiveness of Cooperative Learning Strategies in Multicultural University Classrooms.* Journal on Excellence in College Teaching, 5(1), 21-30.

8. Hawkins, P., & Winter, J. (1997). *Mastering change: Learning the lessons of the enterprise in higher education initiative.* London: Department for Education and Employment.

9. Jablonski, Joseph R. (1994). *Implementing TQM: Competing in the Nineties Through Total Quality Management.* Albuquerque, NM : Technical Management Consortium, Inc.

10. Narayanan, Mysore. 2002. *Learn, how to Learn.* Eos Transactions : American Geophysical Union, Vol. 83, No. 47, Fall Meeting Supplement, Abstract ED52A – 0009, page F 323

11. Poirier, Charles C., and Steven J. Tokarz. (1996). *Avoiding the Pitfalls of Total Quality.* Milwaukee: ASQC Quality Press.

12. Ross, Joel E. (1993). *Total Quality Management: Texts, Cases and Reading.* New York: St. Lucie Press.