

## Enhancing Student Education through Quantitative Reasoning

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### Abstract

The University of Texas at San Antonio began a five year plan in fall 2011 to integrate quantitative reasoning (QR) skills across various disciplines in the general education curriculum. Prior to each fall semester, a team specializing in quantitative literacy (QL), writing, and course redesign train faculty to enhance their course with QR. The University funds the initial faculty group and subsequently supplies the faculty with supplemental support for teaching assistants. After enhancing their course with QL, the faculty members become the mentors for others in their discipline. The courses taught by the faculty members are then considered a Q-course. The results of academic year 2011-2012 and 2012-2013 will be presented. Some of the results will include the number of students taking a Q-course, the number of faculty teaching a Q-course, and the percent of each domain covered. This program provides sustainability to integrate QL in the general education as a means to enhance student education in quantitative reasoning skills.

**Key Words:** Core Curriculum, Quantitative Literacy, Training Faculty

### 1. Introduction

There is little argument that students require quantitative reasoning skills to be successful in the workforce, evaluate risks, and make decisions in their everyday lives. A recent article from the Association of American Colleges and Universities (AACU) cited Oregon State University President Edward J. Ray's blog – "All successful careers require critical thinking, teamwork, sensitivity to cultural, demographic, economic and societal differences, and political perspectives." – (Ray, 2013) A more pressing problem is – How would you broadly prepare a citizenry for the numerical and quantitative needs of the present and the future? – (Steen, 2001) Many disciplines address quantitative needs with a one course requirement in data analysis; traditionally, the analysis course is in statistics. In 2011 The University of Texas at San Antonio (UTSA) began a five year plan to integrate quantitative reasoning (QR) skills across various disciplines in the general education curriculum. An overview of UTSA's Quantitative Literacy Program (QLP) is offered here as we begin the third year of our program. The program will transform the

environment to one where quantitative reasoning skills are ingrained in the curriculum and the culture of UTSA (QEP, 2010).

Dr. Chris Hill from St. Bonaventure University maintains a website listing as many as 10 Universities and Colleges who have enhanced the general education curriculum with quantitative literacy: Augsburg College, Central Washington University, Dartmouth, DePauw University, Hollins University, Lawrence University, Macalaster College, Samford University, Trinity College and University of Massachusetts (Hill, 2013). At Augsburg College two of the skills required for graduating students are critical thinking and quantitative reasoning. (Augsburg, 2013) These skills are embedded throughout many courses and meet the graduation requirements of several majors. The Dartmouth Center for Mathematics and Quantitative Education started a program called Chance. (Dartmouth, 2013) The Chance program reports meeting quantitative literacy needs across a variety of courses. UTSA is at the forefront of the universities in the country who have embedded quantitative reasoning skills in the common core curriculum taken by students from all disciplines. UTSA's focus on requiring all students (over 26,000 undergraduate students in fall 2012) to participate in quantitative literacy is unprecedented.

## 2. Background

### 2.1 UTSA's QLP

Prior to each fall semester a team specializing in quantitative literacy (QL), writing, and course redesign train faculty to enhance their courses with quantitative reasoning (QR). The University funds the faculty groups and supplies the department with supplemental support funds for teaching assistants. The courses taught by the faculty members are designated as Q-courses. If multiple sections are offered for a course, then only the sections taught by the faculty who participated in the redesign and those who are trained by the QLP team are designated as Q-sections.

UTSA also has a plan to sustain the program beyond the initial funding. Each department recognizes the need to support the QLP in the general curriculum; faculty merit evaluations now include incentives for participating in QLP and offering Q-courses. The faculty members who redesign their courses for QL will become the mentors for their colleagues who may teach the enhanced courses in future semesters. A QLP team of faculty specialists work with all participating faculty (those already in QLP and those new to QLP) in meeting the requirements of the program.

The program also has a plan to collect student performance data from each course. The student performance data and satisfaction surveys from stakeholders are used in annual reports to the Provost and the rest of the UTSA executive team on the progress of the program. The university provides the resources needed to sustain the program. Funding for the QLP comes from the Provost through the Dean of University College. The Teaching and Learning Center helps faculty with their course redesign. The Writing Program assists faculty with communicating QL concepts through writing. The authors who are charged with the task of implementing QLP assist faculty members in each discipline with creating pre and post tests and mid-semester Q-assignments. The Testing

center administers a Quantitative Literacy Assessment Test (QLAT) to all entering freshmen and will administer an exit test for seniors.

To support QLP, UTSA now requires students to take at least one Q-course as a graduation requirement. However, QLP is implemented in such a way that a student taking multiple core courses at UTSA will be taking multiple Q-courses, often in the same semester.

### 3. Results

#### 3.1 The Support Teams

At the beginning of each semester the testing center administers the Quantitative Literacy Assessment Test (QLAT) to all incoming freshmen. The QLAT is a measure of freshmen quantitative reasoning skills. The QLAT will also be administered to a select group of seniors prior to graduation; the exit QLAT scores will be used as one measure of progress of the QLP.

The Teaching and Learning Center (TLC) offers support to all Q-faculty members. They offer course redesign techniques required to enhance their course goals and outcomes with quantitative literacy. The writing program offers example rubrics along with a multitude of writing options to help students communicate effectively. The QLP team, consisting of the authors and two members from TLC and the Writing Program, helps Q-faculty meet the goals of the QLP. The QLP team assists faculty members with designing pre/post tests and mid-semester assignments which address quantitative student learning outcomes. The QLP team developed a three day workshop designed to introduce new Q-faculty to the requirements of the program; second year Q-faculty mentor and offer testimony of 'what worked' for the new Q-faculty. The team works with all faculty members throughout the summer to ensure that the redesign of the Q-courses are completed and the faculty are comfortable with the student learning outcomes and data collection methods before the fall semester starts.

The QLP has employed one of our own College of Business graduate students to work on marketing the program to the students and faculty. This QLP staff member assists with the web design, creates flyers, banners, t-shirt logos and works with interdepartmental correspondence. She attends school functions when applicable to raise awareness for the program. She also works with advisors to ensure the program goals (for example, ensuring that each student takes at least one Q-course) are understood and met.

The QLP team trains teaching assistants for each department to assist with grading and collecting item level student performance data. Supplemental funding for teaching assistants comes directly from QLP funds. The team holds a workshop each fall and spring to assure teaching assistants understand how to use the data collection template. The data collection process of the pre/post testing and the mid semester course assignments plays a large role in validating the need of the program. The results from the analysis of the student performance data will be presented in a future paper.

### 3.2 Enhanced Courses

This semester 129 course sections are identified as Q-sections. Many of the disciplines listed below have designated all course sections as a Q-course:

Anthropology	Biology	Chemistry
Economics	English	Environmental Science
History	Math	Multidisciplinary Studies
Philosophy	Political Science	Sociology
Statistics	Writing	

To date, the Quantitative Literacy Program has trained 75 faculty members and 58 teaching assistants.

### 3.3 The Students

Students who enroll in a Q-course will understand how to evaluate, interpret, write and use data in the discipline pertaining to the course and in their everyday lives. Since its inception more than 27,000 students have taken a Q-course. Enrollment totals for the most recent three fall semesters are presented in Table 1:

Table 1: Student enrollments in Q-courses in the most recent three fall semesters.

Semester	Student Enrollments
Fall 2011	3,490
Fall 2012	6,165
Fall 2013	9,371

Student responses have been positive. A freshman Biology major commented, “I felt like I learned more in my Q-courses, and I really enjoyed the different learning style.” Another student commented, “To be honest, I don’t care much for writing, math, or science... but when I tell my friends about my Q-course, they wish they had taken it instead of the other writing courses that aren’t quantitative.” Some Q-courses have participated in a quick course diagnosis (QCD) to establish a student perspective of the course. The results are positive. A larger sample of QCDs will be conducted in fall 2013 semester and the results will be presented in a future paper.

## 4. Summary and Future Directions

UTSA’s five year program to integrate quantitative reasoning (QR) skills across various disciplines in the general education curriculum began in 2011. (QEP, 2010) The first phase of the program (AY 2011-2012) began with enhancing 6 general education courses with quantitative reasoning skills. Biology and

Anthropology enhanced all sections with QR; more than 2,000 were enrolled in these classes in the fall and 1,300 in the spring. Economics and Sociology enhanced up to 3 sections the first year as a pilot but now have all sections enhanced with QR. Two of the original six disciplines are not currently involved with the project. Student enrollments for the first six disciplines were over 3,000; consisting of 104 sections and 21 trained faculty members.

By the second year (AY 2012 – 2013) we added six more disciplines to the program: Chemistry, History, Math, Political Science, Statistics and Writing. Forty-five faculty members across 180 sections were now trained to enhance their discipline specific course with quantitative reasoning. The number of students enrolled in a Q-course by the second year of the program was over 6,000.

In the third year of the program (AY 2013-2014) we trained nine faculty members from four new disciplines: English, Environmental Science, Multidisciplinary Studies, and Philosophy. We also trained new faculty from additional sections of designated Q-courses. To date, fourteen disciplines have enhanced their course with quantitative reasoning skills. The university has grown the quantitative literacy program to include 75 trained faculty members. This semester more than 120 course sections are designated as a Q-course with student enrollments greater than 9,000.

One of our program goals includes developing quantitatively trained students. Q-courses are spread out among 14 disciplines and quantitative reasoning skills are embedded within each section. One way to evaluate the program's success will be from student performance data we collect from the QLAT, the exit QLAT, pre and post-tests, and mid-semester assignments of each discipline. Our next step will be to create higher level challenges of what we expect students to know in the general course sections. Our future plans will be to identify (through a list of attributes) upper division courses that are already data intensive and add them to the list of Q-courses. We also plan to collect student performance data from these upper division courses as an added method to confirm the success of the program. This plan will satisfy yet another QLP program goal; to transform the environment to one where quantitative reasoning skills are ingrained in not only the curriculum, but also the culture of UTSA. (QEP, 2010)

### **Acknowledgements**

E. Orta and K. Massaro are QLP faculty specialists who work with faculty in enhancing their courses with quantitative literacy. R. Boppana is the director of QLP. The authors thank Dr. Nandini Kannan, who was the lead of the faculty team that developed the Quantitative Literacy Program and served as the first QLP director. Dr. Gail Pizzola, the director of the Writing Program, Dr. Patricia Verdines, Teaching and Learning Center, Dr. Danielle Lyles, QLP team member and faculty of the Mathematics Department, participated in many discussions on QLP implementation. Ms. Kimberly Ward worked with the authors in training TAs and with the data collection process.

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