A University-wide Effort to Enhance Classes with Quantitative Literacy

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QLP
QUANTITATIVE LITERACY PROGRAM
UTSA Quality Enhancement Plan

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Abstract

The University of Texas at San Antonio, through the Quantitative Literacy Program, is making a university-wide effort to incorporate quantitative literacy into all core classes. Over the last two years, the UTSA Writing Program initiated a pilot "Q-Course" in writing. In Freshman Composition I classes, students conduct in-class experiments or activities, do research, and write formal quantitative research papers and general audience articles. In Freshman Composition II, students write persuasive papers, prepare graphs, tables, and charts, and present their findings. The Writing Program is now entering year 2 and the results of our efforts are described in this paper.

Acknowledgements: We would like to thank Dr. Gail Pizzola, the Director of the UTSA Writing Program for all of her encouragement and support for bringing quantitative literacy to the Writing Program, and to the Quantitative Literacy Program for funding our efforts making it possible to attend the Athens Institute, June, 2012 and 2013. We would also like to thank Dr. Rajendra Boppano, Ermine Orta, Patricia Verdines, and Kimberly Massaro of the Quantitative Literacy Program for their support and assistance through our learning process.

Introduction and background

An overview of Quantitative Literacy Program

In this new data-rich global environment, there is a critical need for students to have the quantitative reasoning skills to understand and evaluate data to make informed decisions. In 2010 UTSA implemented a Quantitative Literacy Program (QLP) as its Quality Enhancement Plan. QLP addresses this need by providing students with an enhanced curriculum that seamlessly integrates quantitative reasoning and communication skills in courses across the undergraduate curriculum (www.utsa.edu/qep).

The student learning goals of the QLP helps students (a) acquire basic quantitative literacy skills, (b) effectively communicate the results of their quantitative analysis, and (c) acquire discipline-specific advanced quantitative skills.

The QLP has broad-based support across the University and represents a truly collaborative effort to increase the quality of the undergraduate education at UTSA. The University has committed $4 million of new funds over the five-year period (www.utsa.edu/qep).

The Quantitative Committee is now in its third year with 278 sections now enhanced with quantitative literacy and spanning the many disciplines of Biology, Economics, Statistics, Writing, English, Anthropology, Sociology, History, Political Science, Chemistry, and Interdisciplinary Studies. In year one, 36 faculty and, in year two, 41 faculty across these disciplines were trained in enhancing their courses with quantitative skills and activities .

The Committee's vision statement is this: Within the next five years an exemplary program will be implemented to prepare students to effectively use quantitative reasoning to make decisions in their personal and professional lives.

The overarching goal of the QLP is to instill quantitative reasoning skills in undergraduate students at UTSA and cause institutional transformation in the methods used to enrich the curriculum.

The Quantitative Literacy Program at The University of Texas at San Antonio is committed to the following goals:

Program Goal 1: Develop Quantitative Skills in Undergraduate Students.

Program Goal 2: Implement effective teaching pedagogies and assessments to support the development of an exemplary quantitative scholarship program at the undergraduate level.

Program Goal 3: Provide the organizational framework and resources for an institutional transformation to graduate a quantitative, informed citizenry consistent with the mission and vision of the University (www.utsa.edu/qep).

"As a Program Coordinator for UTSA's Quantitative Literacy Program (QLP) I have gained a wealth of information from each team of professors we work with. In the beginning, the QL team had exactly one way to enhance a course with quantitative literacy (QL). Our professors have introduced a variety of ways to enhance their course through QL. While most naturally introduce QL ideas (i.e. reading or creating charts and graphs) early in the semester it was intriguing to see how they weaved it into their course work. UTSA's vision to enhance the core curriculum with quantitative literacy has grown through our professors willing to incorporate new methods for integrating QL into a course" (Ermine Orta, QLP Program Coordinator.

An Overview of The Writing Program, QL Enhancement, Year 1

About 4000 undergraduate students each fall and 3000 each spring enroll for WRC1013 Freshman Composition I and WRC 1023 Freshman Composition II classes, which are required core classes for all students. In Fall 2012, four classes in each course (I and II) piloted enhanced standard freshman composition classes by introducing quantitative literacy. WRC1013 is an informative writing class where students learn to research, generate data in class activities, summarize, describe, or interpret data, create basic data visualizations, and give oral presentations of a research project. WRC1023 is an argument class where students focus on persuasion, oral presentation, analytical skills, extensive library research, and documentation.

The two freshman composition courses were enhanced as part of a grant for participating in the university-wide effort to enhance or redesign all core classes with quantitative literacy. This year, the grant was renewed to continue our efforts in improving pre- and post-tests, quantitative assignments, rubrics, and to assist other faculty members in enhancing their own WRC1013 and WRC1023 assignments.

As part of the quantitative literacy (QL) faculty, and to meet the requirements of the grant, all QL faculty, including two from the Writing Program, attended training sessions to help revise syllabi and class activities to include quantitative elements. All QL faculty were instructed to give pre- test quantitative literacy quizzes, include two to four assignments with quantitative elements, give students a post-test, and submit all scores to the Quantitative Literacy Program for assessment.

Assignments were to include and be assessed on the following criteria (taxonomy levels):

Explore: students demonstrate the ability to explore data to define problems and identify solutions in real-world contexts

Visualize: students demonstrate the ability to visualize data in various graphical and tabular forms

Assimilate and Assess: students demonstrate the ability to assimilate and assess information from different sources, multiple representations of data, methodologies, and studies

Logic: students will demonstrate the ability to use logic I computing and interpreting probabilities, evaluating risks, and understanding the concept uncertainty

Understand: students demonstrate the ability to understand units of measurement and scale and limitations of data analysis

Analyze: students demonstrate the ability to analyze data using different quantitative methods and draw appropriate conclusions

Translate: students demonstrate the ability to translate quantitative language into verbal assumptions and vice versa

Express: students demonstrate the ability to express quantitative evidence effectively in oral and written communication

Each of the criteria has three tiers: basic, intermediate, and advanced. This is based on Norm L. Ebb's model of Depth of Knowledge.

All faculty were given training and much needed support by instructional design specialists who assisted in redesigning courses, quizzes, and grading rubrics. Dr. Patricia Verdines assisted the Writing Program instructors.

"The Quantitative Literacy Program (QLP) provides an opportunity for faculty to explore instructional strategies to develop student quantitative literacy and writing skills in relation to specific concepts in a discipline. We also extended their course assessment tools, so that both the student writing and quantitative literacy skills could be clearly assessed in terms of specific grading criteria. The resulting Q-course could be easily shared with other Faculty at the Writing Program, so that many more students could benefit from it, enhancing their learning experience and quantitative literacy skills" Patricia Verdines, Instructional Design Specialist.

Since the implementation of QL to the Writing Program in 2012, approximately nine WRC1013-Q and eight WRC1023-Q classes, of 25 students each, have piloted the Writing Program quality enhancement program.

The QL enhanced Writing Program goals that were identified are:

- Use writing and reading as resources of inquiry and communication by using numeric sources or datasets, and

- By the end of the first year of composition, students should be able to apply reading, writing, and research literacy skills in communication while using numeric sources and visual data sets.

In 2012-2013, WRC1013-Q (Freshman Composition I) students wrote five papers based on quantitative activities in class. In paper 1, students researched temperatures for one city in Texas in June 2011. Students learned to write summaries, incorporate and cite sources, and to make tables and graphs on Excel. Students were assessed on Explore, Visualize, and Express.

In paper 2, students were given small containers of black and white beans and determined the proportion of black to white beans. After 12 trials, students made predictions about the proportion of the 13th trial. Students wrote brief papers that included an introduction, 2-3 research questions, a description of the methods, and our findings. Students incorporated at least one visual, typically a table or bar graph that was labeled in MLA format. Students were assessed on Explore, Analyze, Visualize, and Express.

In paper 3, students were given Benford's Law about the probability of random natural numbers, the class results of Greg Leibon's class from the Dartmouth University, and our class results. Students researched Benford and Leibon, wrote introductions that included their research and citations, wrote research questions, wrote about their findings in terms of comparison of the three data sources, and a conclusion. Students were assessed on Explore, Analyze, Visualize, and Express.

In paper 4, students were introduced to OCEAN, a quick personality assessment quiz, and given the "average male" and "average female" results. Students compared the class results, their

individual results, and the average results, as a baseline, in their paper. Students included line charts, compared results, and wrote about their findings. Students also included brief research about OCEAN. In this assignment, students were encouraged, by extra credit, to attempt to display the data in non-traditional data displays. Students were shown a collection of contemporary data visualizations for inspiration. Most students produced at least three additional data visualizations using either JMP or Excel. Students were assessed on Explore, Analyze, Visualize, and Express.

For paper 5, students worked in groups and designed a survey after briefly researching a topic of interest such a student stressors. Students completed surveys in class and, as a group, prepared visuals and an oral presentation. Individually, students wrote papers that incorporated research and visuals, properly cited, and summarized the data gained from surveys. By the time students gave oral presentations to the class over the survey findings, students were able to confidently talk about the survey findings and make professional quality visuals. Students were assessed on Explore, Analyze, Visualize, and Express.

Each paper had a rubric that was provided to the students along with a checklist. Because students perceived the assignments as rather complex, the rubric and checklist helped clarify the assignment and assure the student that all of the required elements were accounted for before turning in their papers. These checklists and rubrics also helped the tutors assist students with their assignments. As the semester progressed, checklists and rubrics became more generalized. Rubrics also further defined the tasks for each paper by Explore, Analyze, Express, and Visualize. These scores were reported to the QLP committee for statistics Pre-and post-tests were given to all students. Here are the results for WRC1013-Q for fall 2012 and spring 2013pre- and post-tests. Students were assessed on Explore, Analyze, Visualize, and Express.

In 2012-2013, in the four WRC 1023Q classes (Freshman Composition II) students learned to apply research literacy skills to the collect, interpret, summarize, and report data. Throughout the semester, students either referenced or created at least one data set and/or statistical reference, translated data, by providing a brief summary that included numerical context, created visuals from which inferences were made. Students learned to use the data in their arguments. In addition, students communicated the results of their researched arguments via other genre (oral/visual presentation). The master syllabus including QL enhancement was released to Writing Program faculty. In spring 2013, faculty will pilot quantitative literacy enhanced courses. QL Assignments developed and piloted in 2011-12 will be available for faculty use.

In WRC 1023-Q, students are required to write arguments based on their research. Students can better argue any topic by finding and using data as evidence for their claims. For example, in the three-part Researched Argument Project, students use research skills to explore statistical references, translate data, summarize main observations, create graphs and charts, and argue their interpretations in written, oral, and visual form. Students were assessed on following criteria: Explore, Express, Visualize and Translate.

In 2012, WRC 1023 students completed two major QL projects. However, because of the Researched Argument project's three-part scaffold nature, students were able to develop their reading, writing, and research literacy skills in communication while using numeric sources and visual data sets throughout the semester. Student skill level in Researched Argument Project is

currently being assessed using rubrics designed to assess writing assignments containing QL elements.

- to explore data to define problems and identify solutions in a variety of real-world contexts;
- to visualize data through converting information into different graphical and tabular forms;
- to read an article/report and write about the data presented in report; and
- to effectively communicate the results of data analysis and present conclusions.

Both the annotated bibliography and research argument assesses quantitative writing skill using the Grading Standard for Q-Writing Assignment rubric.

More specifically, with the Researched Argument Project part I Annotated Bibliography students translated a data set and/or statistical reference, by providing a written summary, with numerical context, that included the main observations and conclusions represented by their data. In the annotated bibliography, the SLO Explore (intermediate) was achieved when students applied reading, writing, and research literacy skill in communication while organizing and summarizing collected data.

After completing the annotated bibliography, students used the information therein to formulate their researched arguments. In writing their arguments, students accomplished the Express SLO (advanced) as they used sources, identified rhetorical strategies, and summarized interpretations of quantitative data. Students created and made inferences from visuals, and defended overall conclusions interpreted from data and other sources.

In the oral presentation, students accomplished the SLOs Visualize (intermediate) and Translate (intermediate) by demonstrating the ability to making verbal assertions about the data found in their researched arguments, using appropriate visuals, technology, and limited text. A separate rubric to assess student performance was generated.

Near the end of the semester, students were asked to write a reflection paper about their experience in a WRC1013-Q enhanced course. The following reflection paper was typical of most responses:

I am thankful for having chosen a Q course for writing composition because I found the quantitative aspect of the course both challenging and insightful. The incorporation of quantities and data representation in writing makes this course different from other writing composition courses and was difficult to understand at first, but by the end of the course I had gained valuable skills, especially for my major. I am an accounting major so learning how to display/represent data in a paper with the use of tables and figures, I assume, will be helpful later on in my career.

I thought the Q aspect of the course was fun, actually! I think very mathematically and I enjoy making precise graphs and tables. I enjoyed doing those things much more than writing the actual papers. Having these activities as part of my writing composition course made making papers more bearable.

I am definitely going to incorporate the knowledge I gained in this course in my future courses. I now know how to properly put tables and figures into papers, which in my opinion is a valuable skill. Learning how to make those figures, tables, and graphs is a skill itself which I learned in this course. Being able to take data and compact it into a graph/figure/table is important, but it's crucial that it is easy for the reader to read and understand (Taylor Byrd, UTSA WRC1013-Q student).

Student Support and The Writing Center

The Writing Program at UTSA includes a Writing Center with 22 tutors and 2 interns; 15 have a Bachelor's degree, 6 are currently enrolled in a graduate program, 1 has a Master's degree and 1 has a MFA degree. The tutors' fields of study include: French, Sociology, Classical Studies, Linguistics, Studio Art, History, English, Creative Writing, Professional Writing, Mexican American Studies, Public Relations, Interdisciplinary Studies, Economics, Latin American Studies, Japanese, Political Science, Physics, Math, and Counseling. Last year two Q-tutors were added to assist students in writing quantitative papers. About 30 computers are available to students to work in a quiet environment and print their papers. Overhead projectors are available for instructors' use when the room is reserved for an entire class. MLA and APA workshops are offered throughout the year. From 1/1/2012 to 12/31/2012 the Writing Center had 9,501 visits by students.

As Year One Concludes

We feel that our first year designing and testing QL assignments, writing rubrics and pre- and post-tests and training students was very successful. We have been awarded a grant for year 2 to improve upon our efforts.

We compared the first and last papers in both WRC1013-Q and WRC1023-Q. We wanted to see if there was an improvement in quantitative literacy in our students at the end of the semester. The results are shown in Figure 1 at the end of this paper.

During the WRC1013 first semester, the average of paper 1 was 74 and 73 for paper 4; in the second semester, the average of paper 1 was 77 and 83 for paper 4.

During the WRC1023 first semester, the average of paper 1 was 69 and 76 for paper 4; in the second semester, the average of paper 1 was 69 and 81 for paper 4.

Every semester but one, showed an increase in the ability to express quantitative information in writing.

In Fall 2013, all sections of WRC1013 will be required to include one or more quantitative literacy assignments. Over the last two years, faculty has been introduced to quantitative literacy through faculty departmental meetings and through Q-tips, a faculty newsletter that included assignment ideas, websites, visuals, and other helpful information. A bank of assignments and argument topics will be developed for faculty use, as well as selecting essays for the department common reader that demonstrate quantitative inquiry. Excel tutorials will be added to the Blackboard Learn system for student access. All assignments, rubrics, quizzes and exercises will be evaluated, improved, and made available to faculty.

All sections of 1023 were required to begin using the QL enhanced syllabus in Fall 2012. The new syllabus includes a core curriculum requirement that graphic data representations be added to papers and presentations. Faculty will continue QL training and implementation of writing assignments that promote quantitative literacy. Faculty input from Spring 2013 semester will be gathered and recommendations duly considered. The Q presentation rubric and Writing Standard for Q Assignments will be adjusted as needed. Excel links, research argument topics, assignment sheets, and rubrics will be available to faculty via Blackboard Learn.

A mentorship program will be implemented to support faculty with assignments, assessments, and problem solving. TAs will assist faculty in recording grades to report to the Q-committee for assessment.

Based on the success of our first year introducing quantitative writing to the Freshman Composition classes, we believe that having a department-wide writing program, now enhanced by quantitative inquiry, will better help prepare students for upper division courses, graduate work, and professional employment in their fields.

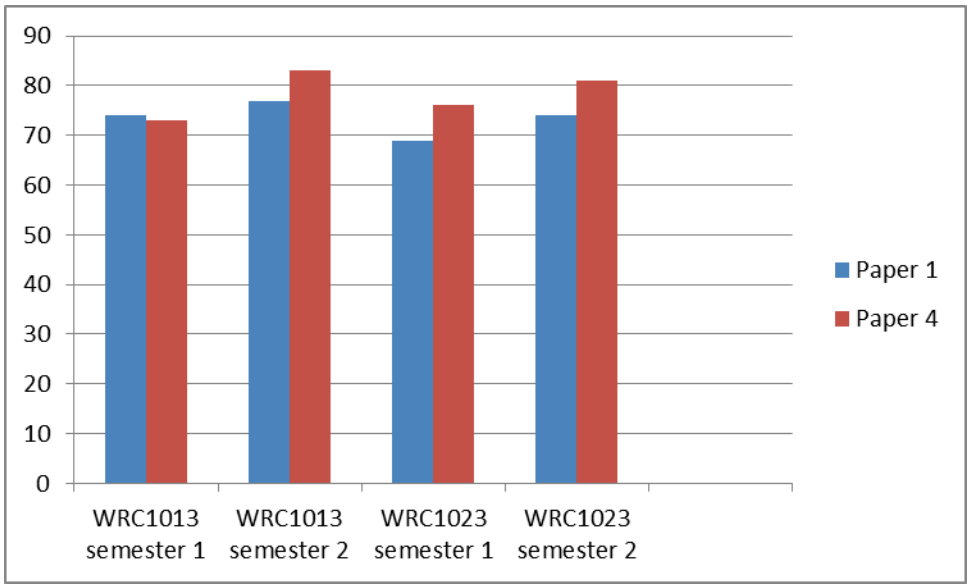

Figure 1. WRC1013 and WRC1023 Paper 1 and Paper 4

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