Developing Quantitative Literacy Through Writing

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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. For the last two years, the UTSA Writing Program initiated a pilot "Q-Course" in writing. In these classes, students conduct in-class experiments and do research, write formal quantitative research papers and general audience articles, prepare graphs, tables, and charts, and present their findings. This year, quantitative literacy was added to the persuasive writing classes. Some of the exercises and assignments that we have tested, as well as an evaluation rubric, and the form for a quantitative research paper, are discussed in this paper.

Developing Quantitative Literacy Through Writing

Two years ago, the University of Texas at San Antonio began to introduce quantitative literacy into all core classes. The Writing Program at the UTSA offers two core curriculum classes in writing composition, WRC 1013, an informative writing class, and WRC 1023, an argument (persuasive writing) class. About four thousand students a year come through the Writing Program.

Last year The Writing Program tested a pilot course with one instructor teaching WRC 1023, and later that year teaching WRC 1013. Both sections of the writing composition classes were enhanced by adding quantitative exercises and assignments. We call these Q classes for quantitative-literacy enhanced. Many assignments were designed, tested, and revised. The second year, another four courses were taught and a second instructor taught four Q-classes of writing argument. This year, the two instructors were awarded a grant by UTSA's Quantitative Literacy Program to enhance all writing courses to help students understand, evaluate, and write about data, and to assist other instructors in incorporating the use of quantitative information into their writing composition courses. By Fall, 2013, all Writing Program instructors will have available to them training and mentorship in using existing quantitative-based activities or in designing their own assignments.

In WRC 1013, informative writing, students learn how to research, synthesize their research into papers, and to cite and document their sources. With quantitative literacy enhancements, students will now generate or research data from which students will write and visually communicate their findings. Students will write for a variety of audiences and purposes. After the successful completion of WRC 1013, students enroll in 1023, a course that focuses on persuasion and argument. In the quantitative-literacy enhanced WRC 1023, students use data as evidence to support their arguments.

Here are some of our favorite exercises for informative and persuasive writing that we found successful in our classes.

Informative Writing Assignments

Proxemics (introducing research questions). I begin every semester with this popular exercise. Based on my readings about proxemics, I begin to select about four students as they are coming in and settling into their places. I usually choose a shy student, an international student, an aggressive student, and an older student, some male, some female. I ask these students to step outside the classroom while I explain our "experiment" to the class. In my experience, the shy student and the international student will keep some distance between us, especially if I don't make eye contact or smile. If the international student is Asian, he or she will not come as close to me as a Middle Eastern student who is usually more comfortable in closer proximity. The

aggressive student will be standing toe to toe to me, and the older student will keep a respectful distance. I tell the class my predictions about how close each student will approach me. I make a mark on the blackboard or on the floor indicating my prediction for each student. I stand at the far end of the classroom and ask each student to come in one by one. We then see how accurate my predictions were. I talk about how I predicted the distances, whether I was right or wrong, how the four students decided how close to approach me, and what the class's predictions were. Sometimes students have actually hugged me or picked me up and set me down again. Whatever happens, the students become comfortable in class with each other and with me, and curious about the kinds of class activities to come. With this exercise, I introduce the idea of starting with a research question and trying to generate information to answer that question. I can also explain the difference between a hypothesis, a null hypothesis, a thesis, and a research question. I explain the purpose of the research question is to guide the research to find the answer, for instance, how close will an older female student approach me compared to a younger female student? If I make a firm prediction, I am making a hypothesis, for example: a younger female student will approach me more closely than an older female student. And, of course the null hypothesis is that there is no difference between the distances a young female and older female will approach me. Students can begin writing research questions from this exercise or do research in proxemics, and then write about proxemics in general and about our class experiment.

Perfect Mate (introducing visuals). Depending on the size of my class, I separate males and females into two or four same-gender groups. I ask each group to list traits for an ideal mate. If the room is large enough, I keep the males and females out of hearing range of each other. Once all groups have completed their lists of traits, I ask the males to go to the chalkboard or overhead projector and share their traits with the class. Last semester, in four classes, the most frequently listed trait by males was that a female could cook. We have an open discussion about the preferred traits and then have the females list the traits of their perfect mate. For females, being tall was the most frequent response. Usually we have some overlap in traits and I can introduce a Venn diagram. We also talk about bar graphs and tables and how to number and title them in a paper. I sometimes also ask students to locate related articles to include in their papers to practice incorporating quotes and citing sources.

Probability of numbers (writing about methods and results). This is one of my favorite assignments, and this semester, the students' favorite too.   I explain to students that I have often wondered if some numbers appear more frequently than others. In my readings, I came across Benford's Law where he predicted that the number 1 would appear 30.1 % per cent of the time, number 2 would appear 17.6 % of the time, 3 appears 12.5 % , 4 appears 9.7%, 5 appears 7.9%, 6 appears 6.7 %, 7 appears 5.8%, 8 appears 5.1%, and 9 appears 4.6 % of the time. Professor

Greg Leibon at Dartmouth College conducted this experiment with his classes and found that 1 appeared 43%, 2 appeared 14%, 3 appeared 11%, 4 appeared 9 %, 5 appeared 8%, 6 appeared 5 %, 7 appeared 3%, 8 appeared 4%, 9 appeared 3%.

 I ask individuals or small groups to come up with five random digits. I use my zip code as an example, 78230. Once they have decided on the five digits, I ask them to create a new number by adding a digit from 1-9, in front of their five digits. So, for my example, 78230 becomes 178230, 278230 . . .978230. I ask them to search Google for each six digit number with the word nature added to it. My first search, "178230 nature" showed 188,000 hits.

To save time, I allow small groups of students (who brought laptops) to locate these numbers and share the information, but they must later write individual papers using the information. It takes about five minutes to search for all nine digits with the word nature. Once they have the number of search hits for each number, they can easily find the percentages and compare their results with both Leibon's class and Benford's Law. Within about 20 minutes, students have constructed a table showing their results, as well as Leibon's results, and Benford's predictions. Of course results vary from group to group, but the real challenge is in organizing information, finding a point of focus (Benford's Law), comparing results, creating a table or other visual, and writing with clarity and precision.

M&Ms (research, comparison, synthesis, methods, results, graphs, writing). Many math and statistics teachers are familiar with this exercise but I have added a few more advanced components to the basic exercise so that students have more information to synthesize and write about. I ask students to locate an informal experiment conducted by Josh Madison (see joshmadison.com). Madison found that the M&Ms Consumer Affairs Office predicted each bag of M&Ms would contain a certain number of candies, and of that number 24% would be blue, 16% green, 20% orange, 13% red, 13% brown, and 14% yellow. He bought 48 packs of M&Ms and compared the color frequencies with the company's predictions. I ask each student to bring two packs of M&Ms on a certain day. We break into small groups and each group counts the number of M&Ms per pack and notes the numbers of each color. When all groups are ready, each group adds its information to a table I have drawn on the blackboard. When the table is complete, groups total the frequencies of each color. At the end of the day when all of my classes have finished this part of the assignment, I post the results for all four classes. I do this because I want students to see the difference in using only a small sample size from their group and a larger sample size using results from four classes. I ask them to compare these results with Josh Madison's and with those of the Consumer Affairs Office. From this information, they make a table and at least one other graph such as a pie chart. .For this assignment the writing focuses on an introduction, the methods (how we collected information), the results, and incorporating

graphs within their paper. They will cite Josh Madison and the M&M Consumer Affairs office in their papers and on a works cited or references page.

Survey (using data generated in class to write about findings and represent findings in graphs). Another long-time favorite of mine, the survey. About midterm students are starting to feel the stress of the semester. In class we talk about student stressors, sometimes throwing in a little cause and effect, for instance, rest, exercise and diet as it relates to stress. I then lead the class into a discussion into what makes life good. What do individuals believe brings them happiness? The conversation will lead to many topics that are of interest to students. Sometimes it is illegal downloads of music; sometimes it's about relationships. I briefly introduce writing surveys, types of questions, and survey design, but I do not grade surveys, so I do not put much emphasis on survey methodology. Small groups begin by finding a topic of interest and developing three research questions they would like to answer. Next, groups write a survey and bring enough copies to the next class for everyone. Having small classes of 25 makes this a very manageable project in three class periods. We stack the surveys on a long table and, smorgasbord style, each student takes a survey from the table. Usually we test about 8-10 surveys. They return the surveys to the table and then groups recollect their surveys and begin studying the results. From this, students will design appropriate graphs or tables. For the writing assignment, I ask that students begin with an introduction, the research questions, a small methodology section that includes information about the demographics of their participants, the findings, figures or tables, and significance. Significance, I explain, is the "so what?" of the paper. I remind students of the proxemics exercise from the beginning of class and explain that understanding about how comfortable various cultures feel with proximity helps me respect different students' cultures. Or I ask students if each of them believes he or she has the same chance of earning an A in class. They believe that they do. I share that education research finds that females will make better grades in a class without males, and that males often make higher grades than females because they are more outspoken in class. Knowing these kinds of biases helps me stay objective in giving grades. Males and females also communicate differently, understanding the different communication styles would be helpful to anyone at the workplace. These are examples of the "so what?" or the significance of the findings to our research questions. I sometimes add more depth and challenge to this exercise by requiring research into their topic before the students design the survey and have them cite the research in the paper. I always require that the paper includes a small section where they analyze how well the survey worked, if it answered their research questions, and what they would do differently next time. This analysis works well for their conclusion. This assignment covers all of the skills already introduced and adds new skills along with critical thinking.

Although all of these assignments are suitable to teach students to write formal, research-based, academic papers, I also encourage students to take the same information and write an article for a general audience and to submit their articles to a community newspaper, school newspaper, or other publication. Writing for publication makes writing real for students and gives them a sense of pride when they are published, even if it is only a letter to the editor in the local paper. Students also make presentations at the end of the semester over an experiment they have located either through an academic database or Dan Ariely's website, danariely.com. Ariely is the author of *Predictably Irrational* and has a website where he discusses his many social science experiments. Most of the topics appeal to college students. It's at this point I get to hear each student talk about experiments that interest them and by the end of the semester, they are able to easily read, understand, and articulate research findings in journal articles. This writing assignment gives the instructor real insight into how the student not only writes, but thinks, a higher-level skill that we all want to instill in our students. Writing, after all, is a physical manifestation of what we think and how we organize information. Semester after semester, I am amazed at the improvement in students' cognitive skills. It's both writing and presentation that makes this clear.

Persuasive Writing Assignments

Risky Behaviors. I'm really impressed with the writing this assignment draws from students. For this assignment, I have students go to the CDC.gov website where there is a link to several pages of tables that lists the self-reported risky behaviors of black, white, and Hispanic teens and the outcomes of those behaviors This could be a comparison, research, or argument paper. It's also one of those teaching moments to talk about stereotypes, biases, and so on. Because the site provides only tables of data without interpretation, students must read and understand the table, and synthesize the material to write about and graph. For additional class discussion or reading, have students review the controversial *The Bell Curve*. The book discusses race, ethnicity, poverty, education, crime, and other topics. Students could also use this book to write about the methodology of the researchers or as a topic for presentation.

Sentencing By the Numbers. The following article, "Sentencing by the numbers," by Emily Bazelon, appeared in The New York Times Magazine on January 2, 2005, p. 18.

"This article describes a risk scale that is actually being used. In 1994 the Virginia state sentencing commission carried out a study to determine which nonviolent offenders could be kept out of prison without posing a risk of committing new crimes. They followed 1,500 nonviolent drug, larceny and fraud offenders for three years after release from prison. They found that men were 55% more likely to be rearrested than women, and offenders in the 20's

were a much higher risk than offenders older than 40. Also being unemployed made offenders more likely to carry out another crime. The same was true for being single.

This study led the commission's director, Richard Kern, to design a simple 71-point scale of risk assessment to aid judges in their sentencing. If an offender has a score of 35 or less, probation or house arrest is suggested rather than jail. A score higher than 35 suggests a jail sentence.

This model was tested on prisoners released five years earlier. Of those who scored below 35, 12 percent committed new crimes as compared to 38% for those who scored higher.

These are only suggestions, so Judges are not required to use this risk scale. However, the scale is being used and has solved some of the overcrowded problems Virginia had for its jails."

I ask students to find and bring to class the state statistics for non-violent crimes, repeat offenders, recidivism, and sentencing. After reading the article in class, I put students in small groups and ask them to devise a scale by which they would evaluate the risk of a non-violent offender and, based on the students' risk scale, who gets probation and who gets jail time. Students usually come up with about 12 risk factors for their risk scale. For instance, more males commit crimes than females, so being male may be worth 5 points; younger people commit more crimes than older people, so being within a certain age range will earn anywhere from 0 to 5 points. Students decide the score that determines probation or jail. This leads to very interesting class discussions and persuasive writing for or against using the scale, and justifications for their risk factors based on their research.

When students write articles for a general audience, I usually ask them to go to the publication's website and locate the writer's guidelines and write accordingly. For a formal, quantitative research paper, I give students the following form with instructions. The review of literature can be a separate assignment that comes first, or used in a more advanced class.

The Common Form for a Quantitative Research Paper (student instructions)

Abstract. This precedes the introduction and is a short paragraph, 100-250 words, that summarizes the research, investigative strategy, results, and conclusion. It sometimes has an introductory sentence, body of methods and findings, and a conclusion suitable for a wide variety of audiences. It highlights major points of the content, answers why your work is important, what was your purpose, how you went about your project, what you learned and what you concluded.

Introduction. This is an introduction and overview of your research project. Discuss your project in general terms to begin laying a foundation of understanding for your reader. This is about 3-5 paragraphs in a well-developed or advanced paper, 1-2 paragraphs in the smaller practice writings.

Statement of the Problem. This section is sometimes blended in with the introduction depending on your project. Where the introduction was general, now we begin to focus and write more specifically and with details, especially in the methods and findings sections. An example of a statement problem would be: The number of disabled college student grows each year. During periods of rapid growth, disabilities services for students are sometimes overlooked creating undue hardship on disabled students.

Review of Literature. Find a minimum of 5 academic sources that relate to your project. You will be discussing research that has been done before your study and begin building your foundation. What is already known, what are the hot topics in debate, what needs to be known and understood? What new insight or information can your research provide? Be sure to cite the studies and list them in the references (APA) or Works Cited (MLA).

Your basic research paper will include two or three research questions you hope to answer, for example:

Research Question 1. Are technology labs at my university accessible to students in wheelchairs and do they adequately meet the students' needs?

Research Question 2. Do visually impaired students feel they have equal access to university resources?

Or if you writing a more advanced research paper, you would include two or three hypotheses. These are statements your research will prove or disprove. Here are some examples:

Null Hypothesis: There is no effect on grades when disabled students access support services, or an alternative **Hypothesis 1**: there is an increase in grades when disabled students access support services.

Methodology. How will you conduct this study? This section must be very detailed and specific. Will you use surveys? How many? Given to whom? How? Will it be an observational study? Where? Who? When? How? Take this section slowly, write carefully and give lots of details.

If you include a section on Limitations, address problems and obstacles to your study.

Findings. Be specific. What are the results of your study? What was the outcome of the survey or observation? How do your findings relate to the studies in the review of literature? To your research questions? Tables and figures help illustrate the findings, number them, use titles, and captions. Make them consistent and follow the chosen style guide.

Significance of Study. Why is your study important? What findings are important and why?

Conclusion. Present your research questions, findings, significance, and make recommendations for further study.

References. (APA) or Works Cited (MLA). List every source used in your paper.

Appendix. Include any additional information that would otherwise interfere with the flow of the paper, for instance, large charts, letters, a map, handout, the survey.

Format: MLA and APA have different styles of cover pages, citations, and tables and graphs. Consult the appropriate handbook and keep it consistent.

<h3 style="text-align:center">Evaluating the Formal, Quantitative Research Paper</h3>

Many instructors from disciplines other than English or Writing tell me they are uncertain as to how to evaluate writing. The following rubric addresses both quantitative skills and writing skills. I use the rubric as a checklist. Proficiency at only the basic Level 1, earns a C. Level 2 measures proficiency in both writing and quantitative understanding; if students have mostly progressed successfully through Level 1 and 2, they earn a B. Proficiency at Level 1, 2, and 3 earn an A. When the rubric is returned with the assignment, the student can see for themselves where they need improvement. I learned this semester that most of my students were taught to print instead of cursive writing and they find it difficult to read my handwriting. The checklist was helpful to us both.

<h3 style="text-align:center">Quantitative Writing Rubric</h3>

Proficiency at Level 1 only = C; Level 1 & 2 only = B; Levels 1, 2, & 3 = A. By proficiency, I mean the majority of the skills are evidenced in assignment. In Level 1, for example, 7 or more skills are evident, in Level 2, four or more, in Level 3, two or more.

Level 1 (Mechanically Correct Documents):

a. The document follows the style guidelines: New Times Roman, 12 pt. font, double-spaced with one inch (1") margins.

b. The document has a title and a header that includes the student/author's name.

c. The document meets the length requirements.

d. The document meets the topic guidelines.

e. The document has in-text citations.

f. The document has a works cited (MLA) or references page (APA).

g. The document has no spelling errors.

h. The document has passed the grammar checker (no green underlines).

i. The document is turned in on or before the due date.

j. The document does not use the first or second person.

k. The document does not use empty phrases such as "today's society" or "there are some similarities and some differences." It also avoids "since the beginning of time."

l. The figures and tables have appropriate numbers, titles and labels. (such as Figure 1. Title)

Level 2 (Factually Correct Documents):

a. The document correctly establishes the context (who, where, what, when and why).

c. The document uses appropriate graphs and tables to convey the meaning of the research.

d. The document does not contain false, misleading, or unsubstantiated statements.

e. The document clearly and accurately describes data.

f. The document is clear and organized.

g. The document gives simple context for numerical values.

Level 3 (Elements that provide new insights to the reader):

a. The document is interesting, current, fresh, and insightful.

b. The document goes beyond the requirements of the assignment.

c. The document provides new insights to the reader or points to future research.

End

Required CV:

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Education
University of the Incarnate Word, 33 postgraduate hours, research and statistics
St. Mary's University, MA, English, Distinguished Graduate
University of Texas at San Antonio, BA, Anthropology
Graphic Arts program through New Horizons and through ACCD.

Writing, Quantitative and Visual Literacy related classes, workshops, conferences
Writing for newspapers, Cary Clark, SA Express News, Gemni Ink
Data Analysis with Software Applications, Introduction to SAS, Introduction to Research
Methods & Quantitative Statistics, Research Methods (3 courses), Research Statistics, Statistics
for Publication, Introduction to Statistics, Teaching Adult Learners, Statistics refresher workshop
through UTSA Statistical Consulting Office 2011, Data Visualization and Data-driven
Journalism, Strata Conference 2012, Texas Tribune and NPR, Data-driven journalism
unconference, March 2012.

Employment
UTSA, Lecturer III, teaching Writing for Anthropology, Writing for Quantitative Literacy,
Writing for the Sciences, Freshman Composition, and Technical Writing, online classes.
Designed classes for Writing for the Sciences, Writing for Anthropology, and Writing for
Quantitative Literacy. Published student textbook for writing and quantitative literacy.
Participated with students and the Fredericksburg Nimitz Museum for the Oral History Program,
student papers now part of the National Archives. Participated with students and The City of San
Antonio for an ethnographic study of Southtown. Assisted students in publishing articles in
Stirpes Journal. Awarded a grant, and serving as head of committee to incorporate quantitative
literacy in core writing classes.

Publications and Presentations: *The Co-Dependent Personality* (internal publication for
HCCADA, 1996), *Kerr County Statistical Manual*, 1997, *Developing Quantitative Literacy
through Writing*, 2011, in addition to numerous articles and corporate publications. Presented
Developing Quantitative Literacy through Writing at the Hawaiian International Conference for
Arts and Humanities, 2011, presenting at the 6th Annual Athens Institute for Education and
Research, Math and Statistics Education, June 2012.

Clinical Research and Writing: Westminster Worldwide, (Viagra and other studies). Wrote
structural and functional tests for Oracle database, data entry guidelines, validation tests and

plans, and all documentation related to various pharmaceutical research protocols, data management, edit checks, cleaned data, tested CRFs and assisted in getting new studies underway with design of questionnaires and data validation tests.

Technical Writing: United Airlines Services Corporation for the Office of the Surgeon General. Designed and developed training manual for computer conversion program (AMEDPASS). Interviewed subject matter experts and synthesized materials, designed layout, editing, and other publishing activities. Security Service Federal Credit Union, wrote computer conversion manual.

Science Writing: Southwest Research, wrote science articles for publication and edited scientists' articles.

Newspapers and magazine writing: Mountain Sun (weekly column), Northside Recorder, The Downtowner (owner and publisher), San Antonio Monthly Magazine. Also wrote advertising copy and radio commercials for Kerr County social service agencies.