

-----QUANTITATIVE REASONING-----

changes in demonstrations; addition of bibliography, suggestions for further study
[December 29, 2000]

Rationale: In all areas of public and community service, as well as in our roles as citizens and consumers, we are confronted with information in the form of quantitative data. This information may be included in news stories, journal articles, political pamphlets, or other media. It may be presented in the form of graphs, tables, or integrated into written text. Our actions as workers, citizens and consumers can often be strengthened through attention to quantitative reasoning. Further, we can often understand issues more deeply by gathering quantitative data that are not initially presented --- in other words, data about which we must ask.

In order to make informed decisions in our actions as workers, citizens and consumers, we need to consider quantitative as well as qualitative information.

Competency: Can use numerical information to gain insight and understanding and draw conclusions about public and community issues.

Criteria: The student must demonstrate the ability to:

1. Understand and draw conclusions about public and community service issues when dealing with quantitative information about those issues. In particular:
 - where argument is supported by quantitative reasoning, understand and draw conclusions from short readings about these issues
 - verify the calculations in an argument about public and community service issues that relies on quantitative reasoning
 - understand how to read graphs or charts about such issues and know how to work with different kinds of charts and/or graphs in getting information about the situation summarized in those graphs and charts
 - understand and draw conclusions from quantitative information about public and community service issues presented in other media besides articles or graphs/charts, such as political cartoons or advertisements
2. Use quantitative information about public and community service issues to construct arguments, drawing conclusions about those issues.
3. Present numerical information in effective ways.

Standards: In all the Criteria, you will be evaluated on the reasoning you use to get your answer, as well as the accuracy of your answer. This will involve demonstrating the ability to:

- interpret and estimate quantities, including very large and very small values
 - extract quantitative information from graphs, tables, news stories, journal articles, or other media
 - present quantitative information in graphical, tabular or other written forms
 - compare quantities using differences, ratios, rates, and percents
 - interpret and apply descriptive statistical concepts appearing in various media, including measures of central tendency (mean, median and mode) and the results of surveys
 - recognize and pose real world problems involving the use and/or collection of data
- For all the Criteria, use of a calculator is encouraged.
1. In the readings referred to in Criterion (1a) you will be asked to briefly discuss the main point, how the numerical information supports (or does not support) that point, and what other quantitative data you could examine to further learn about that point. You may be asked to use the given numbers and your basic quantitative skills to gain more information about the situation (i.e., to create and solve some math problems that are meaningful to the analysis of the argument). Further, you may be asked to solve a math problem that involves making reasonable assumptions about rounding the data, choosing which given data are relevant, discussing which missing data would be relevant, and/or performing multiple operations with very large or very small numbers, in order to solve the problem.
 2. In the arguments referred to in Criterion (1b) you will be asked to show how each number in the argument was gotten from which previous data, or if some of the information is missing, you will be asked to state which information you would need and how you would go about verifying the calculations if that missing information were provided. Further, you will be asked to discuss possible sources from which you could find the missing information. You will also be asked to use the numerical and other evidence to evaluate the reasonableness of the argument.
 3. In the graphs and charts referred to in Criteria (1c) you will be asked to explain and evaluate the kinds of numerical questions that are answered by the graphs and charts, and the kinds of numerical questions that cannot be answered, and why. It will also involve solving problems whose solution involves gathering information from one chart to operate on the information from the other graphs/charts. Further, you will be asked to describe what kind of raw data was used to construct the graphs and charts. Finally, you will be asked to draw conclusions from the information presented in the graphs and charts and to indicate what other kinds of numerical data you would want to clarify or deepen the conclusions that can be drawn from the given graphs and charts.
 4. In the other media referred to in Criterion (1d) you will be asked to describe the main argument. You will be asked to explain how the numbers support (or do not support) the point of the argument. You will be asked to judge if the use of numbers in the presentation (picture, TV show, etc.) clarifies or obscures the point of the argument. You will be expected to reason quantitatively about at least two media other than prose or graphs and charts.
 5. For Criterion (2), you will be expected to be able to use "raw" numerical data that you are given and also to be able to collect and /or research a small amount of "raw" numerical data that you can then use to construct an

argument about a public and community service issue. You will be expected to detail how the numerical data support the argument, and discuss what kinds of data might be collected that would further strengthen or challenge your argument.

6. For Criterion (3) you will be expected both to criticize others' summaries of data, re-presenting the data in clearer graphs or charts, and also to present the data given to you or gathered by you in Criterion (2), in clear forms. By clear forms, we mean graphs or charts that summarize all the data in ways that make the main conclusions that can be drawn from the data easy to understand and that do not mislead the reader to draw incorrect conclusions.
7. For all of the Criteria, you will be expected to use a calculator in order to compute with real (i.e., 'uneven,' large or tiny, 'messy') public and community service data.

Examples of Demonstration: After acceptance to CPCS, all students will participate in an Understanding Arguments (UA) Self-Assessment and Diagnostic process. The Level 1 UA competency involves understanding arguments with quantitative evidence, so this UA assessment process will also lead to advice on how you can prepare for the QR competency demonstration. The first decision will be whether to take an UA class, or to demonstrate the UA competency through prior learning. After demonstrating the UA competency, if you feel you can demonstrate the QR competency through prior learning, you can take a QR Diagnostic. Then, QR advisors will give you a recommendation about the best way for you to demonstrate the QR competency.

For students with prior learning: If you have strong quantitative skills and knowledge and your QR Diagnostic results recommend that you do not need new learning in order to demonstrate the QR competency, you will need to complete two additional pieces of work: a series of separate exercises that reflect the Criteria and that you must do in school (and attain a score of at least 75%); and a mini-portfolio of QR-related work from other CPCS competencies, prior learning, or community projects.

- The exercise set to be completed in school will contain similar problems to those on the QR Diagnostic.
- For the mini-portfolio, the student must select three pieces of prior QR-related work (essays, oral presentations with outlines, visual arts creations, and so on). Then, the student completes the mini-portfolio by writing a cover letter that discusses how the quantitative information used in each piece strengthened or obscured the main point of the piece, and includes questions about other quantitative information that would have been useful to improve each piece.
- Each one must be connected to a different competency completed at CPCS (or a previous school), or connected to a different context of a work project and/or another kind of community project.
- Each of the three pieces must relate to some of the QR competency criteria.
- The mini-portfolio must meet the standards for the writing part of the Level 1 portfolio competency.
- Further, in order to be complete, the mini-project must be revised until all the numerical information in each piece is correct.

A combination of prior learning and new learning: If your QR Diagnostic recommendation was to demonstrate the competency through prior learning, but you feel you need further study, you can work with CPCS math tutors on various Quantitative Reasoning study packets, or you can take home materials from our lab and work independently or with others. You can work with CPCS language tutors as you complete writing your mini-project cover letter. Then you can contact the QR Evaluation faculty person to schedule our in-school evaluation exercises. At any point during this process, you can meet with a QR advisor.

New Learning: If your QR Diagnostic recommendation was to take a class for an in-depth review of quantitative reasoning skills and concepts, you should take a CPCS Quantitative Reasoning class to prepare for demonstration. You can meet with a Quantitative Reasoning advisor to determine which instructional offering is most appropriate to help you complete the competency.

Competencies for Further QR Study

Level 3 in the CPCS curriculum contains two QR electives: Algebraic Reasoning and Statistical Reasoning. When you complete the QR Level 2 competency, you can continue your study of quantitative reasoning by working on the Algebraic Reasoning competency. If you are interested in studying Statistical Reasoning, you first need to demonstrate the Algebraic Reasoning competency.

There are many other competencies in the CPCS curriculum that are QR-related. Some competencies, such as Community Portraits, directly include QR criteria. Other competencies may be learned in a class that focuses on the QR connections. The Instructional Offerings booklet each term will list which classes will include that kind of QR-Intensive focus. For example, some sections of classes preparing you for the Making Arguments competency may focus on making quantitative arguments. But, there may even be some Arts competency classes that involve a QR focus!

QR-Related Bibliography

Once you become aware of how quantitative reasoning can illuminate so many public and community service issues, you will find them in almost every news article, and in many of your academic and work and citizen concerns.

- * At this point in your study, you may want to read the newspaper more carefully, focusing on the quantitative aspects of the issues reported. There are also other news magazines that will give you different, more progressive perspectives than the mass media—*The Nation*, and *The Progressive* are two treating a variety of general public and community service issues. *Dollars & Sense* treats economic issues for a popular audience. *Color Lines* addresses public and community service issues in communities of color.
- * Further, many social change groups use quantitative reasoning to argue their case—Citizens for Tax Justice, 1311 L Street NW, Washington, DC 20005, and World Priorities, which issues quantitative analyses of world military and social expenditures, Box 25140, Washington, DC 20007 are two such groups that publish pamphlets supporting their ideas with numbers.
- * There are also many books that focus on the quantitative aspects of their topics. *Two Nations: Black and White, Separate, Hostile, Unequal* (Andrew Hacker, NY, New York: Scribner's, 1992) and *Take the Rich off Welfare* (Mark Zepezauer & Arthur Naiman, Tucson, Arizona: Odonian Press, 1996) are two examples.
- * Finally, *A Calculating People: The Spread of Numeracy in Early America* [meaning the USA] (Patricia Cline Cohen, Chicago, IL: University of Chicago Press, 1982) is a history of how and why quantitative reasoning became such a central part of our culture.