

## LONGWOOD UNIVERSITY

---

### INSTITUTION

#### **Definition of Competency:**

Quantitative reasoning is the capacity to reason mathematically in everyday life.

#### **Standards for Competency:**

Longwood students will demonstrate quantitative reasoning (QR) by performing the following tasks:

- (1) Interpret mathematical models such as formulas, graphs, tables, and schematics and draw inferences from them;
- (2) Represent mathematical information symbolically, visually, numerically, and/or verbally;
- (3) Use arithmetic, geometric, and/or statistical methods to solve problems;
- (4) Estimate and check answers in order to determine reasonableness, identify alternatives, and select optimal results; and
- (5) Recognize the limitations of mathematical and/or statistical methods.

The above goals are informed by a 2001 report from the Committee on the Undergraduate Program in Mathematics (CUPM) of the Mathematical Association of America (MAA). They also closely match the standards being used to measure Quantitative Reasoning as a part of General Education assessment at Longwood.

Institutionally, we will consider quantitative reasoning (QR) value to have been added if there is a statistically significant increase in QR competency test scores. QR tests will be administered to freshman and senior students beginning with the fall semester 2007 freshman cohort. A representative sample of these scores will comprise the QR competency test scores.

#### **Description of Methodology Used to Gather Evidence of Competency:**

At Longwood, measuring QR competency has been and will continue to be carried out by utilizing internally developed tests that are embedded in the general education courses, and externally developed standardized tests, such as the Major Field Test (MFT) and the Praxis I, developed by Educational Testing Services (ETS). The internal general education assessment corresponds to Longwood University's General education Goal Five standards (see Appendix I) which are closely aligned with the QR standards listed above. The results of this assessment are reported to SCHEV on a yearly basis. The MFT gauges student learning outcomes at the end of senior year and is used internally at Longwood to monitor and improve the programs for which the MFT is given. The Praxis I test gauges student learning outcomes for future teachers (see Appendix II). To further

enhance faculty teaching and student learning in the QRC area Longwood purchased the Maple TA/MAA Placement Test Suite in spring 2007.

In response to a recent call for “value-added” assessment, Longwood proposes to use both direct and indirect measures to determine “value-added” to our student learning and college experience while enrolled at Longwood. The direct measure will consist of a mathematics test administered to incoming freshman and outgoing seniors.

The indirect measure will assess the level of student engagement via the National Survey of Student Engagement (NSSE). The details of the methodology for each of these measures are given below. The students in the freshman 2007 class who have achieved senior status in 2010 will be the first group of students from whom the QR competency test scores and value-added assessment will be measured.

**Direct “value-added” measure:** We will begin by administering a mathematics test via the Maple TA System to at least 90% of our incoming freshmen in the summer and fall of 2007. This test will have a large QR component and will hereafter be referred to as the “QR test.” With few exceptions, the questions on the test are taken directly from the MAA placement tests. Questions are chosen so that, taken together, they cover all the standards for QR competency described in the above section of this plan. Additionally, the QR test may undergo modification so that success on the QR test more accurately reflects success in meeting Longwood General Education Goal Five (see Appendix I) outcomes. The results from this test will comprise the initial QR competency measure for freshmen.

To establish validity of the Longwood QR test instrument, we begin our test with an entire MAA placement test in 2007. Over time, we will continue to collect test data and improve the structure of the QR test so as to increase the consistency in measuring student QR competency in general education and senior year learning.

To assess the extent to which QR value has been added to student learning, beginning in fall 2010, we will give a QR test to a random sample of at least 40 senior students who took the initial QR test in 2007 as freshman. This proposed sample size will be large enough to yield a valid paired t-test. The senior QR test will consist of questions parallel to those on the freshman QR test. More specifically, these particular questions will test identical mathematical skills as those on the freshman QR test, with minimum changes only in the numbers or models used. We will consider “value” to be “added” in QR competency if there is a statistically significant increase in test scores for those seniors from their corresponding initial QR competency measures as freshmen.

**Indirect “value-added” measure:** Since 2000, Longwood has been measuring the level of student engagement via the National Survey of Student Engagement (NSSE). We will continue to use the NSSE, particularly, those items that are included in NSSE questions 1, 2, and 11, as indicators of the two variables, “level of student engagement in analytic activities” and “self-reported learning outcomes in analytic area.” At the end of every other school year, a group of randomly selected freshman and senior students will take

the survey. The mean values for both freshmen and senior classes on these selected items will be analyzed and compared (see appendix III).

Specifically, the proposed analysis procedure on NSSE data includes:

- Using NSSE items to construct two scales, “level of student engagement in analytic activities” (NSSE items Q1-d, Q2-b, c, d, and e) and “self-reported learning outcomes in analytic area” (NSSE items Q11-a,b,c,d,e,f,g,h,j,k,l,m, and n);
- Testing internal reliability of the scales by using Cronbach’s Alpha statistics;
- Calculating mean scores on two scales for the freshman and senior students who participate in NSSE;
- Using a two-sample t test procedure to analyze the difference in group mean values on the scales to demonstrate the added value.

In conclusion, using both direct and indirect value-added measures, findings of the data analyses will be used to support university-wide decision making on program/service improvement.

**Summary:** *(Provide analysis of results)*

*Please leave this section blank for now – results of initial assessment due January 15, 2008.*

## Appendix I: Longwood University General Education Goal Five

GOAL 5: An understanding of mathematical thought and the ability to conceptualize and apply mathematical logic to problem solving (three credits at a commonly agreed upon skills level comparable to college algebra).

Outcomes: Students will

- Understand how mathematical and/or statistical models can be used to study real-world situations
- Understand the limitations of and assumptions behind typical mathematical models
- Use mathematical and statistical analysis to interpret such models by testing hypotheses, making predictions, drawing conclusions, checking results for plausibility, and finding optimal results
- Understand when technology might be helpful in mathematical or statistical analysis and apply technology when appropriate

## Appendix II: Assessment Indicators for MFT & Praxis

Since 2002, Longwood has required a passing score on the Praxis I (which covers reading, writing, and **mathematics**) for students to be accepted in the Teacher Preparation Program.

The items in **bold/italic** below indicate QR portions of the MFT for various programs of study.

- Biology
  - Biochemistry and Cell Energetics
  - Cellular Structure, Organization, Function
  - Molecular Biology & Molecular Genetics
  - Diversity of Organisms
  - Organismal – Animals
  - Organismal – Plants
  - Population Genetics and Evolution
  - Ecology
  - ***Analytical Skills***
- Business
  - Accounting
  - Economics
  - Management
  - ***Quantitative Business Analysis***
  - Finance
  - Marketing
  - Legal and Social Environment

- Information Systems
  - International Issues
- Chemistry
  - Biochemistry
  - *Critical Thinking and REAS ability*
- **Computer Science**
  - Programming
  - Discrete Structures & Algorithms
  - Systems (Architecture, Operating systems, Networking, Databases)
- Criminal Justice
  - Theories of Criminal Behavior
  - The Law
  - Law Enforcement
  - Corrections
  - The Court System
  - Critical Thinking
  - *Research Methodology and Statistics*
- **Mathematics**
  - Calculus
  - Algebra
  - Routine
  - Nonroutine
  - Applied
- Political Science
  - *Analytical & Critical Thinking*
  - *Methodology*
  - Political Thought
- Psychology
  - Memory & Thinking
  - Sensory & Physiology
  - Developmental
  - Clinical & Abnormal
  - Social
  - *Measurement & Methodology*
- Sociology
  - General Theory
  - *Methodology & Statistics*
  - Deviance & Social Problems
  - Demography & Urban /Rural/Community
  - Multiculturalism
  - Social Institutions
  - Social Psychology
  - Gender
  - Globalization

### Appendix III: National Survey of Student Engagement (NSSE)

Every other year, Longwood commissions NSSE to conduct the student engagement survey among a randomly selected sample of freshmen and seniors. The results, particularly the results from the following 18 items will be used as the indicators of the “level of student engagement in analytic activities” and for “self-reported learning outcomes in analytic area.” Thus, the results of a comparison of the group mean values will be used for two purposes: as an indirect value-added measure, and as support evidence to the results of direct value-added measures. Specifically,

Measured on a 4-point scale, the indicators for “level of student engagement in analytic activities” include:

- Q1-d. Work on a paper or project that required integrating ideas or information from various sources (4=very often, and 1= never)
- Q2-b. Analyzing the basic elements of an idea, experience, or theory, such as examining a particular case or situation in depth and considering its components (4=very much, and 1=very little)
- Q2-c. Synthesizing and organizing ideas, information, or experiences into new, more complex interpretations and relationships (4=very much, and 1=very little)
- Q2-d. Making judgments about the value of information, arguments, or methods, such as examining how others gathered and interpreted data and assessing the soundness of their conclusions (4=very much, and 1=very little)
- Q2-e. Applying theories or concepts to practical problems or in new situations (4=very much, and 1=very little).

Measured on a 4-point scale (4=very much, and 1=very little), the indicators for “self-reported learning outcomes in analytic area” include:

- Q11-a. Acquiring a broad general education
- Q11-b. Acquiring job or work-related knowledge and skills
- Q11-c. Writing clearly and effectively
- Q11-d. Speaking clearly and effectively
- Q11-e. Thinking critically and analytically
- Q11-f. Analyzing quantitative problems
- Q11-g. Using computing and information technology
- Q11-h. Working effectively with others
- Q11-j. Learning effectively on your own
- Q11-k. Understanding yourself
- Q11-l. Understanding people of other racial and ethnic backgrounds
- Q11-m. Solving complex real-world problems
- Q11-n. Developing a personal code of values and ethics.