

# The Need to Assess Quantitative Literacy in the Major

Dr. Rodney E. McNair  
Department of Mathematical Sciences  
Delaware State University

The Need to Assess  
Quantitative Literacy in the Major

Different perspective on where and how to assess QL  
provide valuable insights

Assessing general QL levels and development

Developing specialized courses

Mathematics and Statistics

QL Courses in the major

These efforts address the need for a general level of QL  
that can be applied in all areas

Building on and extending these ideas leads us  
to a discipline centric view of QL

## The Need to Assess Quantitative Literacy in the Major

The core concept that drives study in science, business, chemistry, psychology, music, and mathematics is change

Everything changes:

This is why mathematics and QL are  
applicable to everything

There are three things that you can do with change  
and with mathematics

Measure (how big, how fast, rate of change, percent change)

Predict (recognizing patterns and relationships in measurements)

Manage (Make choices based on understanding change)

## The Need to Assess Quantitative Literacy in the Major

Measuring, predicting and managing change are central to every discipline

Business, psychology, and biology students should understand measurement in their major.

What to measure, when to measure, why to measure

Prediction plays a central role in all majors ( the use of technology to gather and analyze data increases the need an ability for prediction)

Recognizing patterns, understanding interactions between variables, hypothesizing, and testing cause and effect relationships

## The Need to Assess Quantitative Literacy in the Major

The ultimate goal in all disciplines is to develop a level of understanding that allows us to manage change in complex systems.

Financial Systems

Biological Processes

Environmental Systems

Understanding change in content specific systems should be a central goal for all majors.

Developing this understanding in the major requires quantitative skills, literacy skills, and mathematics skills

## The Need to Assess Quantitative Literacy in the Major

Developing the necessary quantitative skills and dispositions starts in and depends on the major:

A necessary step toward understanding change in any context involves taking a quantitative perspective.

Perspective may be impacted by personal dispositions and also by content/context goals and objectives

You need knowledge of discipline specific variables, systems, goals, perspectives, values, and expectations will all impact the development of a quantitative perspective.

## The Need to Assess Quantitative Literacy in the Major

There is a tendency to minimize the role of the discipline specific content and goals when discussing quantitative literacy.

Quantitative literacy is viewed as a general skill that is applied to a discipline.

This may underemphasize the importance of QL in the major

Instead quantitative literacy should be seen as the lungs of the discipline that breath life into efforts at greater understanding.

## The Need to Assess Quantitative Literacy in the Major

Quantitative literacy begins as an informal conceptual heuristic approach to seeing and understanding change.

It matures into an attempt to conceptualize general change in a system of change based on the application of mathematical concepts, (matheracy)

It depends on mathematical computation for accuracy and for verification

Mathematics intersects the partner disciplines at stage but most intensely in the last two stages,



## The Need to Assess Quantitative Literacy in the Major

Building on the AACU Quantitative Literacy Value Rubric as a benchmark for assessing general quantitative literacy, I offer a few ideas here for thinking about a rubric for discipline specific assessments.

“Quantitative Literacy (QL) – also known as Numeracy or Quantitative Reasoning (QR) – is a "habit of mind," competency, and comfort **in working with numerical data**<sup>1</sup>. Individuals with strong QL skills possess the **ability to reason and solve quantitative problems**<sup>2</sup> from a wide array of **authentic contexts and everyday life situations**<sup>3</sup>. They understand and can create sophisticated arguments **supported by quantitative evidence**<sup>4</sup> and they can clearly communicate those arguments in a variety of formats (using words, tables, graphs, mathematical equations, etc., as appropriate). “

<sup>1</sup>Not just data but also quantitative and qualitative concepts

<sup>2</sup>Important to be able to “create” quantitative /qualitative problems and **models**

<sup>3</sup>In an effort to develop greater understanding of change in the discipline and in everyday life

<sup>4</sup>And supported by discipline specific concepts, theories, and models

## The Need to Assess Quantitative Literacy in the Major

**“Preliminary efforts to find student work products which demonstrate QL skills proved a challenge in this rubric creation process.** It’s possible to find pages of mathematical problems, but what those problem sets don’t demonstrate is whether the student was able to think about and understand the meaning of her work. It’s possible to find research papers...”

### Implications for the major:

It is problematic to think that such evidence does not exist in the major. Such a situation would lead one to ask just how it is that the disciplines are dealing with the study of how things change in the systems that they are trained to measure predict and manage.

### Implications for the mathematics classroom:

In a qualitative-quantitative-math literacy-mathematics developmental chain, evidence of QL skills in a mathematics classroom may be found in the reason the students are taking the mathematics course

## The Need to Assess Quantitative Literacy in the Major

“Given widespread agreement about the importance of QL, it becomes incumbent on faculty to develop new kinds of assignments which give students substantive, contextualized experience in using such skills as analyzing **(discipline)** quantitative information, representing **(discipline)** quantitative information in appropriate forms, completing calculations to answer meaningful **(discipline)** questions, making judgments based on **(discipline)** quantitative data and communicating the results of that work for various purposes and audiences. As students gain experience with those skills, faculty must develop assignments that require students to create work **(discipline)** products which reveal their thought processes and demonstrate the range of their **(discipline)** QL skills.”

If you put business, psychology, or any other discipline in front of each phrase here then you have a charge to the discipline that addresses industry’s concerns about education outcomes.

## The Need to Assess Quantitative Literacy in the Major

This rubric has been designed for the evaluation of work that addresses quantitative literacy (QL) in a substantive way. QL is not just computation, not just the citing of someone else's data. **QL is a habit of mind, a way of thinking about the world that relies on data and on the mathematical analysis of data to make connections and draw conclusions.** Teaching QL requires us to design assignments that address authentic, data-based problems. Such assignments may call for the traditional written paper, but we can imagine other alternatives: a video of a PowerPoint presentation, perhaps, or a well designed series of web pages. **In any case, a successful demonstration of QL will place the mathematical work in the context of a full and robust discussion of the underlying issues addressed by the assignment**

This requires a sustained engagement in quantitative reasoning over an entire curriculum in the major not just a course or two.

These should be discipline specific goals not just Gen Ed. goals. The disciplines are a major source of underlying issues of change that need to be understood.

## The Need to Assess Quantitative Literacy in the Major

**Interpretation** : *Ability to explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words)*

**Representation**: *Ability to convert relevant information into various mathematical forms (e.g., equations, graphs, diagrams, tables, words)*

### **Calculation**

**Application / Analysis**: *Ability to make judgments and draw appropriate conclusions based on the quantitative analysis of data, while recognizing the limits of this analysis*

**Assumptions** : *Ability to make and evaluate important assumptions in estimation, modeling, and data analysis*

**Communication** : *Expressing quantitative evidence in support of the argument or purpose of the work (in terms of what evidence is used and how it is formatted, presented, and contextualized)*

## The Need to Assess Quantitative Literacy in the Major

Need to continue efforts in all areas (general education, special courses, developmental assessments) and we need to encourage the disciplines to recognize the need to assess quantitative literacy as a major outcome of their programs. Being quantitatively literate in business, psychology, or biology is what it means to be a business person, a psychologist, or a biologist. QL is a measure of disciplinary understanding, as such, it should be taught and assessed as an integral part of the Discipline. As QL requirements become more precise students will need to improve their analysis and prediction skills by improving their math literacy skills and mathematics knowledge.