

# University Learning Goals

---

Eastern Illinois University Council on Academic Affairs

## New Quantitative Reasoning University Learning Goal Adopted

On January 16, 2014, the EIU Council on Academic Affairs adopted revised undergraduate University Learning Goals, which became effective during the Fall 2014 semester. Among the goals is one focused on Quantitative Reasoning:

**EIU graduates produce, analyze, interpret, and evaluate quantitative material by:**

- Performing basic calculations and measurements.
- Applying quantitative methods and using the resulting evidence to solve problems.
- Reading, interpreting, and constructing tables, graphs, charts, and other representations of quantitative material.
- Critically evaluating quantitative methodologies and data.
- Constructing cogent arguments utilizing quantitative material.
- Using appropriate technology to collect, analyze, and produce quantitative materials.

What is Quantitative Reasoning? Sometimes also referred to as Quantitative Literacy, Quantitative Reasoning (Quantitative Reasoning) has been described as a “habit of mind,” a competency and comfort in working with numerical data. Individuals with strong Quantitative Reasoning skills:

- Can reason and solve quantitative problems from a wide array of authentic contexts and everyday life situations
- Can understand and create sophisticated arguments supported by quantitative evidence
- Can clearly communicate those arguments in a variety of formats (using words, tables, graphs, mathematical equations, as appropriate) (AAC&U, 2011)

Numerous sources document that today’s society is imposing ever-increasing demands for quantitative reasoning (Dingman & Madison, 2010). The context or discipline within which quantitative reasoning is applied is an important consideration (Steen, 2004). It is not necessarily a discipline, but a way of thinking that influences what, how, and why



---

### Learning Goals Workshop Series

#### Introduction

February 20, 10 am-noon  
Arcola-Tuscola Room

#### Writing and Critical Reading

February 25, 2-4 pm  
Arcola-Tuscola Room

#### Speaking and Listening

March 3, 2-4 pm  
Arcola-Tuscola Room

#### Critical Thinking

March 21, 11 am –1 pm  
1103 Buzzard Hall

#### Responsible Citizenship

March 24, 2-4 pm  
Arcola-Tuscola Room

#### Quantitative Reasoning

April 1, 10 am-noon  
Arcola-Tuscola Room

---

(continued from page 1)

students learn what they do.

Accordingly, a quantitatively literate college graduate should be able to (Sons et al, 1996):

- Interpret mathematical models such as formulas, graphs, tables, and schematics, and draw inferences from them.
- Represent mathematical information symbolically, visually, numerically, and verbally.
- Use arithmetical, algebraic, geometric and statistical methods to solve problems.
- Estimate and check answers to mathematical problems in order to determine reasonableness, identify alternatives, and select optimal results.
- Recognize that mathematical and statistical methods have limits.

#### **Challenges for Students:**

- Math anxiety and math phobia – immediate association with former mathematical training
- Ability to apply one's knowledge to everyday problems across a number of contexts, and using various strategies
- Technology anxiety
- Fluency in formal mathematical skills and statistics

Traditional approaches to mathematics often do not engage many students, who may need a different path in order to succeed. Developing and applying quantitative reasoning in a variety of contexts may well enable students to understanding how quantitative reasoning works in

a variety of disciplines (The College of New Jersey, n.d.). It also increases the likelihood that students will be presented with Quantitative Reasoning problems that may be of greater relevance of interest to them. "Thus quantitative material needs to permeate the curriculum, not only in the sciences but also in the social sciences and, in appropriate cases, in the humanities, so that students have opportunities to practice their skills and see how useful they can be in understanding wide range of problems." (Bok, 2006)

#### **Challenges for Instructors**

- Intentionally incorporating quantitative reasoning goals and objectives into courses
- Clearly defining course goals and performance standards for Quantitative Reasoning
- Structuring courses that are not "mathematics-centered" courses, but instead, incorporate Quantitative Reasoning that fits naturally within the contexts of disciplines and courses
- Utilizing different approaches to promote a student-learning environment, including lecture, collaborative groups, active learning, peer instruction etc.
- Wide range of contexts in which this type of reasoning is needed – requires flexibility of the instructors' knowledge and understanding of working in these contexts
- Ensuring that students are armed with the skills they will

need before they are asked to apply them

#### **Best Practices in Teaching**

The Numeracy Infusion Course for Higher Education (NICHE) website provides numerous examples of teaching practices that support development of quantitative reasoning:

- Real World Applications & Active Learning, including Discovery. Studies show that most students learn more when engaged in active learning. Don't simply show them how to work with numbers; let them get involved.
  - Use real-data, or data simulations
  - Role play in a case-study
  - Involve students in the data collection process
  - Request that students interpret tables and charts rather than providing the information for them
  - Ask students to postulate potential explanations for published findings (for e.g. from newspapers)
- Pairing Quantitative Reasoning instruction with Writing, Storytelling & Critical Reading  
To become fully quantitatively literate, students must be able to communicate their quantitative arguments, first by analyzing the quantitative analyses of others, and then communicate their own.
  - Provide quantitative writing assignments that require students to grapple with

- numbers in a real world context, to describe observations using numbers, and to use the numbers in their own analyses and arguments.
- Use backwards-design by focusing on what needs to happen first (for e.g., class activities, earlier assignments etc.) to arm students with the tools to complete the assignment.
- Using Technology, including computers. The use of technology can actively engage students in Quantitative Reasoning work, promote logical thinking and help students master Quantitative Reasoning skills that are central to the research process.
  - Numerous software packages are freely available to students, including discipline-specific and survey software.
  - Spreadsheets allow students to ‘get their hands dirty’ by working with real-world data. Allow students to create ‘what if’ analyses from concrete examples.
- Collaborative Instruction & Group Work. Interdisciplinary and collaborative approaches, including group work, are effective strategies for promoting mathematics and Quantitative Reasoning education.
  - Use groups for Quantitative Reasoning assignments, incorporating research, spreadsheet manipulation, statistical analysis and presentation.

- Use small-group learning exercises to read and evaluate data.
- Pedagogy that is sensitive to cultures & learning style. Students’ perceptions of quantitative reasoning, their academic, and their development as quantitatively literate citizens all depend on our ability to engage all our students, not just our “math whizzes” and high achievers.
  - Working cooperatively, promoting discussion and idea sharing, and using hands-on materials.
  - Use visualization, icons, symbols, and graphic organizers to represent learning
  - Teach students how to collect, record, and condense quantitative information.
- Scaffolding the Learning Process. Incorporating Quantitative Reasoning assignments are complex because they ask students to combine math skills within the context of a problem and craft an argument around it. Scaffolding early assignments provides students with enough help to complete a task, and then gradually decreases the help as the student becomes able to work independently.
  - Give students rich feedback on the data they propose to use
  - Provide ample opportunities to master the material, particularly if not successful the first time around (NICHE, (<http://serc.carleton.edu/>

NICHE/index.html)

### Best Practices in Assessment

The NICHE website also provides useful assessment practices. The very nature of Quantitative Reasoning poses challenges for traditional assessment tools, particularly by its emphasis on a basic skill set, implementation in context, communication & as a habit of mind. Quantitative Reasoning itself is grounded in context, so assessment tools must be as well.

- Develop and use clear rubrics: AAC&U VALUE rubrics have been used by many. Requires assessing/grading students based on more than the ‘correct’ numerical response (e.g., calculation).
  - Interpretation
  - Representation
  - Calculation
  - Analysis/Synthesis
  - Assumptions
  - Communication
- Complex Quantitative Reasoning skills such as the ability to construct arguments with quantitative evidence are best assessed by essays or oral presentations Multi-choice exams can be useful but only if the options are context-rich.
- Quantitative Reasoning is multi-faceted and requires multi-faceted assessment and multiple tools.
- Assess and use student self-assessment of technical and Quantitative Reasoning skills. (NICHE, <http://serc.carleton.edu/NICHE/index.html>)

### Selected Bibliography

- Association of American Colleges and Universities (AAC&U). (2011) *VALUE: Valid Assessment of Learning in Undergraduate Education*. [www.aacu.org/value/metarubrics.cfm](http://www.aacu.org/value/metarubrics.cfm)
- Bok, D. (2006) *Our underachieving colleges*. Princeton, NJ: Princeton University Press
- Dingman, S.W. & Madison, B. L. (2010) "Quantitative reasoning in the contemporary world, 1: The course and its challenges," *Numeracy* 3 (2).
- Grawe, N. D. (2012, Spring). "Achieving a quantitative literate society: Resources and community to support national change." *Liberal Education* 98 (2), 30-35.
- Grawe, N.D. & Rutz, C.A. (2009) "Integration with Writing Programs: A Strategy for Quantitative Reasoning Program Development." *Numeracy* 2(2).
- Madison, B.L. & Dingman, S.W.(2010) "Quantitative reasoning in the contemporary world, 2: Focus questions for the numeracy community." *Numeracy* 3 (2).
- Madison, B.L. & Steen, L.A. (2003) Eds. *Quantitative literacy: Why numeracy matters for schools and colleges*. Princeton, NJ: National Council on Education and the Disciplines.
- Sons, L. et al. (1996) *Quantitative reasoning for college graduates: A supplement to the standards*. Mathematical Association of America.
- Steen, L.A. (2001) *Mathematics and democracy: The case for quantitative literacy*. Washington DC: Mathematical Association of America.
- Steen, L.A. (2004) *Achieving quantitative literacy: An urgent challenge for higher education*. Washington, DC: Mathematical Association of America.

### For more information

- Quantitative Reasoning, Inquiry, and Knowledge (QuIRK) (Carleton College) <http://serc.carleton.edu/quirk/index.html>
- Quantitative Reasoning Across the Disciplines (QUAD) (Stockton College) <http://intraweb.stockton.edu/eyos/page.cfm?siteID=18&pageID=42>
- National Numeracy Network <http://serc.carleton.edu/nnn/index.html> and Numeracy Journal <http://scholarcommons.usf.edu/numeracy/>
- Numeracy Infusion Course for Higher Education (NICHE) <http://serc.carleton.edu/NICHE/index.html>
- SIGMAA QL – Special Interest Group of the Mathematical Association of America <http://sigmaa.maa.org/ql/>
- Spreadsheets Across The Curriculum (SSAC) - <http://serc.carleton.edu/sp/ssac/index.html>
- Guide to Writing with Statistics (Purdue University Online Writing Lab) <https://owl.english.purdue.edu/owl/resource/672/1/>
- Guidelines for Quantitative Reasoning - The College of New Jersey - [www.tcnj.edu/~conjura/qradvcomm/ReimersComments.htm](http://www.tcnj.edu/~conjura/qradvcomm/ReimersComments.htm)

---

## For More Information



### EIU Council on Academic Affairs:

<http://castle.eiu.edu/eiucaa/>

### CAA Learning Goals Website:

<http://www.eiu.edu/learninggoals/>

### CAA Learning Goals Report:

[www.eiu.edu/learninggoals/pdfs/CAA\\_Learning\\_Goals\\_Review\\_Report\\_Final.pdf](http://www.eiu.edu/learninggoals/pdfs/CAA_Learning_Goals_Review_Report_Final.pdf)

### EIU Committee for the Assessment of Student Learning (CASL):

<http://www.eiu.edu/~assess/caslhome.php>

### EIU Office of the Provost and Vice President of Academic Affairs:

<http://castle.eiu.edu/acaffair/>

### EIU Strategic Plan:

<http://www.eiu.edu/strategicsummary/>

### EIU NCA Self-Study (Accreditation):

<http://www.eiu.edu/nca2014/>

---