GES3: Solve problems using Quantitative Reasoning - Intermediate

GE202X Research and Technology

Semester: FALL 2013

REPORT DATE: 1/8/2014

Introduction:

Quantitative Reasoning was assessed as a pilot in GE202X, Research and Technology, based on the student's final project using the AAC&U Quantitative Literacy Value Rubric. This course introduces students to research design and methodology, as well as to disciplinary and interdisciplinary perspectives of the research process. Students learned how to design and implement a research project appropriate for their major discipline. This course is geared toward freshmen and sophomores although students from all levels are represented. Each course is tailored to the major being taught. For this pilot assessment, the courses that were geared for the Sciences and business majors were selected (4 sections from GE2024 and 3 sections from GE2021 and 1 section from GE2026). This represents 33% of the total sample number (24 sections for all disciplines).

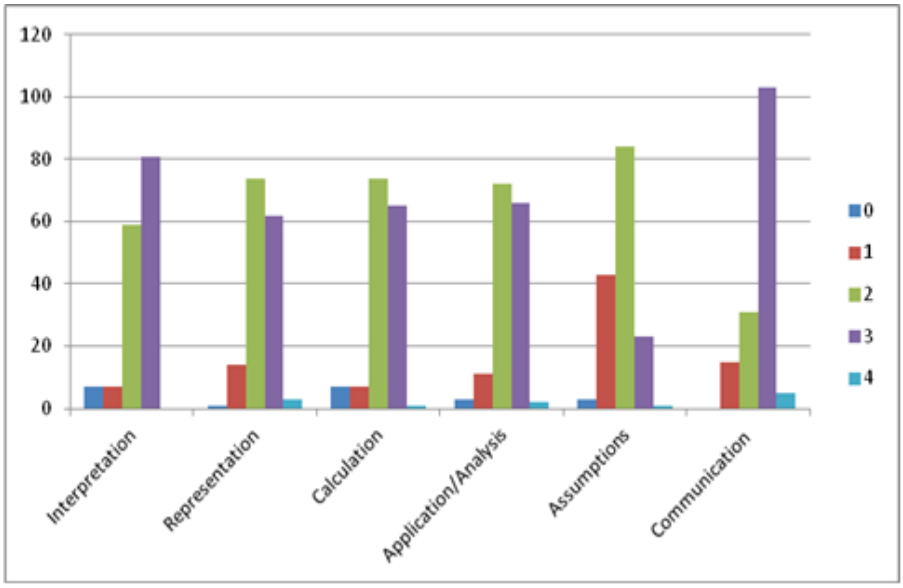
Data:

Sample size for pilot:
Number of students: 154
Number of sections: 8

Mean scores overall:

Criteria	Mean
Interpretation	2.4
Representation	2.3
Calculation	2.3
Application/ Analysis	2.3
Assumptions	1.8
Communication	2.7

Distribution of Scores:

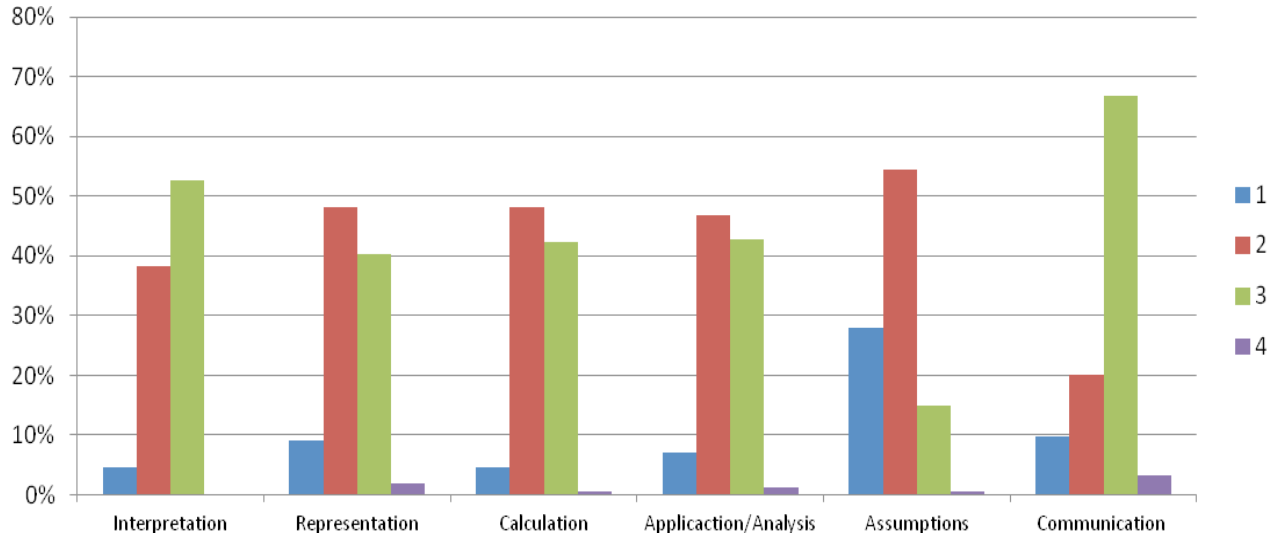


Distribution of Scores:

	Interpretation	Representation	Calculation	Application /Analysis	Assumptions	Communication
0	7	1	7	3	3	0
1	7	14	7	11	43	15
2	59	74	74	72	84	31
3	81	62	65	66	23	103
4	0	3	1	2	1	5

Percentages of score

	Interpretation	Representation	Calculation	Application/ Analysis	Assumptions	Communication
0	5%	1%	5%	2%	2%	0%
1	5%	9%	5%	7%	28%	10%
2	38%	48%	48%	47%	55%	20%
3	53%	40%	42%	43%	15%	67%
4	0%	2%	1%	1%	1%	3%
Level 1-2	47%	58%	57%	56%	84%	30%
Level 3-4	53%	42%	43%	44%	16%	70%



Discussion/Action/Closing the Loop:

The initial implementation of this rubric was performed on a 15-page research paper that students developed across the semester in which they provide an experiment design, discuss the execution of the experiment, and then report and discuss their findings. As initial calibration was performed, it was assumed that the course would fall around the intermediate level with an average score between 2 and 3 (both milestones), after normalization however it was determined that a satisfactory expectation level for the course would be achieving a 3 (milestone).

By looking at the results it is seen that assumptions is the weakest point with averages of 1.84 (84% failed to meet expectation), followed by calculation (2.30, 57%), representation (2.34, 58%) and application/analysis (2.34, 56%). Although assumptions is a subject that is discussed widely in the course, these results suggest that we should do more: a practical exercise might be a way for them to recognize and better understand how to formulate assumptions for their own project. A practical exercise will be provided this semester to test our theory. Also, to fix this weakness, there will be specific lessons that model articles focusing on this topic developed with collaboration from Statistics colleagues. Also with better understanding of the mathematical portion, a group exercise can be developed to determine the assumptions and analysis of diverse scientific articles as well as have each student try to come up with their own as a separate "building block" for their final project with peer as well as instructors' review. These models will be used in the upcoming Spring 2014 semester.

It has also been observed that there is a strong connection between quantitative reasoning in Statistics, and Research and Technology based on the collection and interpretation of data from the methodology and discussion portion of their final research project. It may be of some interest to determine if the placing Statistics into students' curriculum as a precursor to Research and Technology or in conjunction would make an improvement on their scores. To determine the feasibility, a study will be proposed to look at completion rates of students that have taken both courses before, after or in conjunction with each other. This assumption is taken from our results and the fact that not all of them are required to take Statistics at all and for the rest Statistics is not a prerequisite (or co-requisite) for Research and Technology. This leads to the idea of possibility of piloting a paired course in the Fall 2014 semester and/ or recommending the implementation of the designated math (major specific) as a prerequisite for the course.

Appendix: Rubric

Quantitative Literacy VALUE Rubric

for more information, please contact value@aacu.org

Association of American Colleges and Universities

Definition

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

Evaluators are encouraged to assign a zero to any work sample or collection of work that does not meet benchmark (cell one) level performance.

	Capstone	Milestones		
	4	3	2	1
Interpretation *Ability to explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words).*	Provides accurate explanations of information presented in mathematical forms. Makes appropriate inferences based on that information. *For example, accurately explains the trend data shown in a graph and makes reasonable predictions regarding what the data suggest about future events.*	Provides accurate explanations of information presented in mathematical forms. *For instance, accurately explains the trend data shown in a graph.*	Provides somewhat accurate explanations of information presented in mathematical forms, but occasionally makes minor errors related to computations or units. *For instance, accurately explains trend data shown in a graph, but may miscalculate the slope of the trend line.*	Attempts to explain information presented in mathematical forms, but draws incorrect conclusions about what the information means. *For example, attempts to explain the trend data shown in a graph, but will frequently misinterpret the nature of that trend, perhaps by confusing positive and negative trends.*
Representation *Ability to convert relevant information into various mathematical forms (e.g., equations, graphs, diagrams, tables, words).*	Skillfully converts relevant information into an insightful mathematical portrayal in a way that contributes to a further or deeper understanding.	Competently converts relevant information into an appropriate and desired mathematical portrayal.	Completes conversion of information but resulting mathematical portrayal is only partially appropriate or accurate.	Completes conversion of information but resulting mathematical portrayal is inappropriate or inaccurate.
Calculation	Calculations attempted are essentially all successful and sufficiently comprehensive to solve the problem. Calculations are also presented elegantly (clearly, concisely, etc.)	Calculations attempted are essentially all successful and sufficiently comprehensive to solve the problem.	Calculations attempted are either unsuccessful or represent only a portion of the calculations required to comprehensively solve the problem.	Calculations are attempted but are both unsuccessful and are not comprehensive.
Application / Analysis *Ability to make judgments and draw appropriate conclusions based on the quantitative analysis of data, while recognizing the limits of this analysis.*	Uses the quantitative analysis of data as the basis for deep and thoughtful judgments, drawing insightful, carefully qualified conclusions from this work.	Uses the quantitative analysis of data as the basis for competent judgments, drawing reasonable and appropriately qualified conclusions from this work.	Uses the quantitative analysis of data as the basis for workmanlike (without inspiration or nuance, ordinary) judgments, drawing plausible conclusions from this work.	Uses the quantitative analysis of data as the basis for tentative, basic judgments, although is hesitant or uncertain about drawing conclusions from this work.
Assumptions *Ability to make and evaluate important assumptions in estimation, modeling, and data analysis.*	Explicitly describes assumptions and provides compelling rationale for why each assumption is appropriate. Shows awareness that confidence in final conclusions is limited by the accuracy of the assumptions.	Explicitly describes assumptions and provides compelling rationale for why assumptions are appropriate.	Explicitly describes assumptions.	Attempts to describe assumptions.
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).*	Uses quantitative information in connection with the argument or purpose of the work, presents it in an effective format, and explicates it with consistently high quality.	Uses quantitative information in connection with the argument or purpose of the work, though data may be presented in a less than completely effective format or some parts of the explication may be uneven.	Uses quantitative information, but does not effectively connect it to the argument or purpose of the work.	Presents an argument for which quantitative evidence is pertinent, but does not provide adequate explicit numerical support. (May use quasi-quantitative words such as "many," "few," "increasing," "small," and the like in place of actual quantities.)

Description of the assignment being assessed:

Research Project – Based on a topic approved by your professor, the following elements will be submitted in stages and by specified due dates.

♦ Final paper

- Minimum of 15 typed pages of text: 12 pt. font (Times New Roman), double-spaced, 1–inch margins all sides
- Additional cover page including, at a minimum: Title, Student's name, Course name, Section number, Instructor's name
- Outline of the paper in the form of a table of contents
- Additional page(s) containing a minimum of properly formatted reference citations
- Proper APA format. If the student would prefer to use a different format, this MUST be approved at the beginning of the semester
- Standard English grammar, spelling, and punctuation
- Original work of the student